PacifiCorp

Deer Creek Mine
C/015/018

Revised Reclamation Plan
Round Six Review
November 2001

240. Reclamation Plan (R645-301-200)

R645-301-242: Soil Redistribution

At the time of reclamation, PacifiCorp will reduce the footprint of the Deer Creek mine site disturbed area by redistributing soil and spoil material to be consistent with the postmining land use and water drainage system. This will be accomplished by cutting and/or filling the existing mine site footprint in each of the three (3) disturbed canyons; Deer Creek Canyon, Deer Canyon, and Elk Canyon. These areas will be re-contoured as outlined on Drawings DS-1781-D through DS-1784-D in **Appendix R645-301-500-C**.

Deer Creek was developed prior to the Surface Mining Control Reclamation Act and topsoil/subsoil material was never segregated or stockpiled during construction activities. The native soils on steep slopes in the disturbed area provide very little topsoil material. Nowhere in the vicinity of the mine is there a source of material that would usually be referred to as "topsoil". Since it would be impractical and very costly to transport other suitable material to the site, the existing fill material must be examined to determine its suitability for vegetal growth.

The soil material in the existing fills were originally derived from sandstone and shale parent materials from the terraced area on the south side of Deer Creek Canyon. Soil sampling of this area was conducted in 1999. Eighteen (18) samples were taken and analyzed for the parameters described in ~~Appendix A~~ Table 6 of the *Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining* (Leatherwood, 1988). A sample location map of the terrace sampling is included in **Appendix R645-301-200-C**.

The soil material particles are mostly sand with textures from sandy clay loams to loamy sands. The water holding capacity is low, typical of sandy soils. They are calcareous soils as indicated in pH's of 7.5 – 8.5 and calcium carbonate equivalents above 8%. Salt content is too low for any harmful affects on plants. Potassium, phosphate and nitrogen, important plant nutrients, are very low indicating the need for fertilization to insure plant growth. The organic material throughout the disturbed area is principally coal debris, the nitrogen percentage is very low. For a more detailed discussion on soil type, characteristic, and quality, refer to **Volume 2, Chapter 2**.

Track-hoes, rubber tired backhoes, dozers and front-end loaders will be used to recontour the disturbed area. Travel over redistributed soil material will be minimized to the extent possible. This will be accomplished by reclaiming the mine in specific sequences, utilizing existing roads and travelways to live haul substitute soil material. It is important to understand that while reclamation will be specifically sequenced, various stages will be occurring simultaneously throughout the site.

During the operation period of the Deer Creek Mine, a soil sampling program will be implemented (refer to Table 3-1 Reclamation Schedule for implementation of program) to determine the quality of substitute topsoil available for reclamation and to determine if refuse material is toxic- and/or acid-forming. Substitute topsoil must be used since no soil had been previously stockpiled for reclamation purposes. Quality of the topsoil will be analyzed to determine the suitability ~~of the soil~~ for revegetation success. Sampling locations and procedures are described below in complete detail.

As recontouring of an area is completed and available topsoil is redistributed, it will be fertilized, mulched, then roughened by deep gouging (pocking) with a trackhoe bucket or similar equipment that produces a depression approximately 3.0' dia. x 1.5' deep. These depressions will be developed throughout the reclaimed area and will influence the retention of moisture and greatly reduce sediment contributions to stream flow.

R645-301-233 Topsoil Substitutes and Supplements

To provide a suitable topsoil material for reclamation purposes, soil will be qualified through an established sampling program. Sampling will be conducted before reclamation activities commence and taken along the corridor of the existing undisturbed drainage culvert in the Deer Creek Canyon (refer to Table 3-1 Reclamation Schedule for implementation of program). Sample points will be placed randomly along the corridor and be taken at three foot depth intervals to a point four feet below the ~~final~~ grade of the proposed final surface configuration. Samples will be collected by ~~a~~ Energy West staff members qualified in collecting soil samples. If a contractor is used, the person will be trained and qualified to collect soil samples. In either case, R645-301-131 will be followed. The information required for by R645-301-130 will be submitted with the technical data

The cut and fill calculations in R645-301-500 assume that suitable soil in substantial quantity will be located within the corridor of the undisturbed drainage. The areas to be sampled for a suitable substitute topsoil and subsoil ~~will be located at accessible sites between 3+00 and 31+00 (refer to map DS-1810-D in **Appendix R645-301-200-B**)~~ are those areas outlined in the soil sampling program found in **R645-301-200-A**. Sampling will commence during the 2001 and/or 2002 field seasons. Sampling will be conducted through the depth of the available material. The samples will be taken to a reputable soils lab where quality will be determined using the soil suitability criteria of ~~Appendix A~~ Table 2, *Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mines*, Leatherwood and Duce, 1988. The soil sample analysis results will be incorporated into **Appendix R645-301-200-A** of this section when it becomes available. Representative samples (site #1 and site #6; DS-1810-D) have been taken in conjunction with the slope stability study in the spring of 2000. The sample analyses for these sites are included in **Appendix R645-301-200-A**. According to the cut and fill mass balance calculations in the Engineering Section, sufficient quantity of soil materials (topsoil and subsoil) are available to reclaim the Deer Creek Mine as planned. The anticipated topsoil placement location is illustrated on Drawing DS-1816-D in **Appendix R645-301-500-C**. If suitability of the soil material is found to be inadequate, PacifiCorp commits to establishing a new soils plan in cooperation with the Division.

Underground Development Wastes.

The refuse material cut during topographic contouring will be used as fill along cut banks and highwalls. Before recontouring begins, however, a complete sampling program of the refuse piles needs to be implemented so the chemical characteristics can be known. Any acid- and/or toxic-forming refuse fill material found will be covered with four (4) feet non-acid and/or non-toxic forming material. This will be accomplished by one or both of the following methods; 1) excavating a pit to bury the toxic soil material on-site and/or 2) sacrifice non-toxic substitute topsoil covering from certain areas of the mine site to cover the toxic soil material. The soil sampling program will identify problem areas throughout the mine site.

Partial sampling of the underground development waste (refuse) piles located in Deer Creek and Elk canyons was previously conducted (April 2000) in cooperation with the slope stability investigation. Two samples (Site #1 and Site # 6; **Appendix R645-301-200-A**) were taken to determine if the refuse material was acid or toxic forming or could be used as a suitable subsoil substitute. The sample analysis found that SAR's were elevated near the surface in each of the two samples taken. Heavy salting of travel areas during the winter months is most likely the contributing factor. Additional sampling of these refuse piles is planned to be conducted in conjunction with the substitute topsoil material sampling and described below (refer to Table 3-1 Reclamation Schedule for implementation of program). The addition sample analyses will be incorporated into **Appendix R645-301-200-A** as more information is made available. Specific site locations of both previously and planned sampling and their procedures are outlined below.

Sampling Procedures for Refuse Piles

Sampling was conducted while performing slope stability investigations on the slopes of the refuse piles. Test holes were drilled with a rotary rig using water as the drilling fluid and a rock bit with drive casing to advance the holes through the overburden. Sampling was performed at three- to five-foot intervals in the overburden throughout the depth investigated. Both disturbed and undisturbed samples were obtained during field investigations. Disturbed samples were obtained by driving a 2-inch split spoon sampling tube through a distance of 18 inches using a 140-pound weight dropped for a distance of 30 inches.

Undisturbed samples were obtained by pushing a thin-walled sampling tube into the subsurface material using the hydraulic pressure on the drill rig. The location at which the undisturbed samples were obtained are shown on the boring logs in **Appendix R645-301-500-E** and on map DS-1810-D in **Appendix R645-301-200-B**. The document provided in this appendix was assembled by RB&G Engineering Consultants.

Once the samples were analyzed for stability properties, the remnant sample for each site was sent to Intermountain Laboratories for quality analysis. The parameters described in ~~Appendix A~~ Table 6 of the *Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining* (Leatherwood, 1988) were analyzed. Results of the analysis can be reviewed in **Appendix R645-301-200-A**.

To provide sufficient subsoil material for reclamation purposes, refuse will be qualified through an established sampling program. Sampling will be conducted during the 2001 and/or 2002 field season and be taken in the confines of the refuse piles in the Deer Creek and Elk canyons (refer to Table 3-1 Reclamation Schedule for implementation of program). Sample points will be placed randomly in these areas and be taken at three foot depth intervals to a point four feet below the final grade of the proposed final surface configuration. Samples will be collected by Energy West staff members qualified in collecting soil samples. If a contractor is used, the person will be trained and qualified to collect soil samples. In either case, R645-301-131 will be followed. The information required for by R645-301-130 will be submitted with the technical data and incorporated in **Appendix R645-301-200-A**.

R645-301-243: Soil Nutrients and Amendments (Refer to **R645-301-300: Biology**)

R645-301-244: Soil Stabilization (Also refer to **R645-301-500: Engineering** for slope stability analysis)

Various sized rocks and boulders (litter) will be randomly placed on slopes of reclaimed areas where feasible or helpful to control slope slippage and to promote microhabitats. Mid-sized litter material will be placed on the prepared slopes and nested into the soil at random locations. This process will provide a natural esthetic appearance as well as slope containment.

Where it is deemed necessary, especially on slopes greater than 20%, a soil tackifier (refer to **R645-301-300: Biology**, Seeding Techniques) will be incorporated into the reclamation process to stabilize soil material.

Rills and gullies, which develop in areas that have been regraded and topsoiled and which either; 1) disrupts the approved postmining land use or the reestablishment of the vegetative cover, or 2) causes or contributes to the violation of water quality standards for receiving streams will be filled, regraded, or otherwise stabilized.

PACIFICORP

ENERGY WEST MINING

Deer Creek Mine
C/015/018

Mining and Reclamation Plan

Appendix R645-301-200-A

Soil Sample Analysis - Sampling Program
Site #1 and Site #6 Lab Analysis
Topsoil Substitute Sampling
Refuse Pile Sampling

Inter-Mountai oratories, Inc.

1633 Terra Avenue
Sheridan, WY 82801

Energy West Mining Co.
Huntington, UT

Set #0100S09317

Report Date: 06/23/00

Client Project ID: Deer Creek Mine

Date Received: 06/02/00

Lab Id	Sample Id	Depths (Feet)	pH s.u.	Saturation %	EC @ 25°C mmhos/cm	Calcium meq/L	Magnesium meq/L	Sodium meq/L	SAR
100S09317	Site #1 DC1000	0 - 1.5	7.5	27.6	28.5	46.1	35.4	268	42.0
100S09318	Site #1 DC1100	6 - 7.5	7.2	33.7	29.9	33.4	75.0	226	30.7
100S09319	Site #1 DC1200	15 - 16.5	8.0	24.9	7.03	38.6	34.7	23.3	3.85
100S09320	Site #1 DC1300	20 - 21.5	7.5	26.0	4.41	25.5	29.9	6.70	1.27
100S09321	Site #1 DC1400	25 - 26.5	7.5	24.9	4.79	24.6	29.0	7.14	1.38
100S09338	Site #6 DC3100	0 - 1.5	9.0	32.4	7.08	28.4	1.44	45.1	11.7
100S09339	Site #6 DC3200	3 - 4.5	7.7	27.4	10.5	24.1	72.7	46.5	6.68

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed By: ____________________

Joey Sheeley
Soils Lab Supervisor

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Sheridan, WY 82801

Energy West Mining Co.

Huntington, UT

Set #0100S09317

Report Date: 06/23/00

Client Project ID: Deer Creek Mine

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Lab Id	Sample Id	Depths (Feet)	Coarse Fragments %	Sand %	Silt %	Clay %	Texture	1/3 Bar %	15 Bar %
100S09317	Site #1 DC1000	0 - 1.5	44.5	58.0	28.0	14.0	SANDY LOAM	12.8	6.0
100S09318	Site #1 DC1100	6 - 7.5	11.6	31.0	39.0	30.0	CLAY LOAM	18.6	12.4
100S09319	Site #1 DC1200	15 - 16.5	1.7	66.0	24.0	10.0	SANDY LOAM	11.1	4.4
100S09320	Site #1 DC1300	20 - 21.5	0.0	75.0	17.0	8.0	SANDY LOAM	9.9	2.9
100S09321	Site #1 DC1400	25 - 26.5	15.3	71.0	23.0	6.0	SANDY LOAM	11.7	3.2
100S09338	Site #6 DC3100	0 - 1.5	25.8	64.0	24.0	12.0	SANDY LOAM	21.5	7.5
100S09339	Site #6 DC3200	3 - 4.5	11.0	43.0	33.0	24.0	LOAM	17.8	7.5

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Lab Id	Sample Id	Depths (Feet)	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Pot. t/1000t	T.S. ABP t/1000t
100S09317	Site #1 DC1000	0 - 1.5	21.5	0.58	18.1	319	301
100S09318	Site #1 DC1100	6 - 7.5	16.6	0.10	3.12	281	278
100S09319	Site #1 DC1200	15 - 16.5	4.2	0.02	0.62	288	287
100S09320	Site #1 DC1300	20 - 21.5	1.6	0.23	7.19	161	154
100S09321	Site #1 DC1400	25 - 26.5	1.8	0.08	2.50	210	208
100S09338	Site #6 DC3100	0 - 1.5	35.8	1.63	50.9	245	194
100S09339	Site #6 DC3200	3 - 4.5	8.7	0.27	8.43	390	382

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Lab Id	Sample Id	Depths (Feet)	Boron ppm	Nitrogen Nitrate ppm	TKN %	Selenium ppm	Available Sodium ppm	Exchangeable Sodium meq/100g
100S09317	Site #1 DC1000	0 - 1.5	0.94	0.32	0.21	0.76	10.6	3.19
100S09318	Site #1 DC1100	6 - 7.5	0.78	0.32	0.14	0.38	13.4	5.74
100S09319	Site #1 DC1200	15 - 16.5	0.28	5.98	0.04	0.20	1.19	0.61
100S09320	Site #1 DC1300	20 - 21.5	0.16	0.96	0.01	0.16	0.62	0.45
100S09321	Site #1 DC1400	25 - 26.5	0.13	2.92	0.01	0.16	0.57	0.39
100S09338	Site #6 DC3100	0 - 1.5	0.85	0.30	0.48	0.42	3.04	1.58
100S09339	Site #6 DC3200	3 - 4.5	0.53	8.48	0.07	0.36	2.35	1.08

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Lab Id	Sample Id	Depths (Feet)	pH s.u.	Saturation %	EC @ 25°C mmhos/cm	Calcium meq/L	Magnesium meq/L	Sodium meq/L	SAR
100S09340	Site #6 DC3300	6 - 7.5	7.5	30.6	8.90	29.0	84.6	24.1	3.20
100S09341	Site #6 DC3400	9 - 10.5	7.5	32.0	5.91	28.5	35.4	15.9	2.81
100S09342	Site #6 DC3500	12 - 13.5	7.4	30.3	7.16	27.1	32.9	30.9	5.65
100S09343	Site #6 DC3600	15.5 - 17	7.3	27.2	5.18	31.2	19.2	17.7	3.52

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Lab Id	Sample Id	Depths (Feet)	Coarse Fragments %	Sand %	Silt %	Clay %	Texture	1/3 Bar %	15 Bar %
100S09340	Site #6 DC3300	6 - 7.5	35.2	61.0	25.0	14.0	SANDY LOAM	18.5	6.1
100S09341	Site #6 DC3400	9 - 10.5	29.9	77.5	15.0	7.5	SANDY LOAM	10.4	4.9
100S09342	Site #6 DC3500	12 - 13.5	19.3	73.0	17.0	10.0	SANDY LOAM	15.1	5.7
100S09343	Site #6 DC3600	15.5 - 17	29.7	69.0	20.0	11.0	SANDY LOAM	16.4	4.7

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
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Lab Id	Sample Id	Depths (Feet)	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Pot. t/1000t	T.S. ABP t/1000t
100S09340	Site #6 DC3300	6 - 7.5	21.8	1.55	48.4	362	314
100S09341	Site #6 DC3400	9 - 10.5	54.6	0.48	15.0	222	207
100S09342	Site #6 DC3500	12 - 13.5	36.9	0.68	21.2	244	223
100S09343	Site #6 DC3600	15.5 - 17	20.9	0.33	10.3	306	295

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Lab Id	Sample Id	Depths (Feet)	Boron ppm	Nitrogen Nitrate ppm	TKN %	Selenium ppm	Available Sodium ppm	Exchangeable Sodium meq/100g
100S09340	Site #6 DC3300	6 - 7.5	0.73	11.4	0.30	0.44	1.01	0.27
100S09341	Site #6 DC3400	9 - 10.5	0.62	10.3	0.77	0.38	0.78	0.27
100S09342	Site #6 DC3500	12 - 13.5	0.84	9.18	0.58	0.38	1.57	0.63
100S09343	Site #6 DC3600	15.5 - 17	0.68	0.22	0.24	0.28	1.26	0.78

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Lab Id	Sample Id	Depths (Feet)	pH s.u.	Saturation %	EC @ 25°C mmhos/cm	Calcium meq/L	Magnesium meq/L	Sodium meq/L	SAR
100S09338	Site #6 DC3100	0 - 1.5	9.0	32.4	7.08	28.4	1.44	45.1	11.7
100S09338D	Site #6 DC3100	0 - 1.5	9.0	33.0	7.37	30.2	1.42	47.5	11.9
100S09341	Site #6 DC3400	9 - 10.5	7.5	32.0	5.91	28.5	35.4	15.9	2.81
100S09341D	Site #6 DC3400	9 - 10.5	7.5	33.7	5.88	29.6	36.7	16.5	2.86

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

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Lab Id	Sample Id	Depths (Feet)	Coarse Fragments %	Sand %	Silt %	Clay %	Texture	1/3 Bar %	15 Bar %
100S09338	Site #6 DC3100	0 - 1.5	25.8	64.0	24.0	12.0	SANDY LOAM	21.5	7.5
100S09338D	Site #6 DC3100	0 - 1.5	0.0	66.0	22.0	12.0	SANDY LOAM	22.4	7.4
100S09341	Site #6 DC3400	9 - 10.5	29.9	77.5	15.0	7.5	SANDY LOAM	10.4	4.9
100S09341D	Site #6 DC3400	9 - 10.5	0.0	77.5	15.0	7.5	SANDY LOAM	10.4	5.0

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

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100S09338	Site #6 DC3100	0 - 1.5	35.8	1.63	50.9	245	194
100S09338D	Site #6 DC3100	0 - 1.5	35.8	1.62	50.6	241	190
100S09341	Site #6 DC3400	9 - 10.5	54.6	0.48	15.0	222	207
100S09341D	Site #6 DC3400	9 - 10.5	54.6	0.50	15.6	226	210

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed By: ______________________

Joey Sheeley
Soils Lab Supervisor

er-Mountain Lab ries, Inc.

1633 T .venue
Sheridan, WY 82801

Energy West Mining Co.
Huntington, UT

Set #0100S09317

Report Date: 06/23/00

Client Project ID: Deer Creek Mine

Date Received: 06/02/00

Lab Id	Sample Id	Depths (Feet)	Boron ppm	Nitrogen Nitrate ppm	TKN %	Selenium ppm	Available Sodium ppm	Exchangeable Sodium meq/100g
100S09338	Site #6 DC3100	0 - 1.5	0.85	0.30	0.48	0.42	3.04	1.58
100S09338D	Site #6 DC3100	0 - 1.5	0.80	0.22	0.47	0.42	3.10	1.53
100S09341	Site #6 DC3400	9 - 10.5	0.62	10.3	0.77	0.38	0.78	0.27
100S09341D	Site #6 DC3400	9 - 10.5	0.83	10.4	0.76	0.40	0.88	0.33

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed By: ____________________

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Soils Lab Supervisor

Soil Sampling Program*

Type: Substitute topsoil sampling

Date Performed: Field season 2001/2002

Depth: Four (4) feet below final reclamation contour

Location: Accessible sites between 9+00 - 15+00 and 24+00 - 30+00 (refer to DS-1782-D)

Person Performing Analysis: Qualified Energy West personnel

Parameters Analyzed: Refer to ~~Appendix A~~ Table 6 of the *Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining* (Leatherwood, 1988).

* Data from analysis and location of sample points will be placed into this appendix when available.

Soil Sampling Program*

Type: Substitute subsoil sampling (refuse material)

Date Performed: Field season 2001/2002

Depth: Four (4) feet below final reclamation contour

Location: Refuse piles in Deer Creek and Elk canyons (refer to DS-1782-D)

Person Performing Analysis: Qualified Energy West personnel

Parameters Analyzed: Refer to ~~Appendix A~~ Table 6 of the *Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining* (Leatherwood, 1988).

* Data from analysis and location of sample points will be placed into this appendix when available.

PACIFICORP

ENERGY WEST MINING

Deer Creek Mine
C/015/018
Mining and Reclamation Plan

Appendix R645-301-200-B

<u>Soil Sample Location Map: DS-1810-D</u>

PACIFICORP

ENERGY WEST MINING

Deer Creek Mine
C/015/018
Mining and Reclamation Plan

Appendix R645-301-200-C

Soil Sample Analysis for the Terrace Area above Deer Creek Surface Facilities

Inter-Mountain Laboratories, Inc.

16… Avenue
Sheri… WY 82801

Energy West Mining Co.

Huntington, UT

Client Project ID: Deer Creek Mine

Date Received: 12/07/99

Set #0199S19261

Report Date: 01/07/00

Lab Id	Sample Id	pH s.u.	Saturation %	EC @ 25°C mmhos/cm	Calcium meq/L	Magnesium meq/L	Sodium meq/L	SAR
0199S19261	DC0599	7.7	30.3	0.40	1.01	1.45	1.32	1.19
0199S19262	DC0699	7.7	27.7	0.43	0.77	0.98	2.30	2.46
0199S19263	DC0799	7.6	33.2	0.40	1.12	1.48	1.38	1.21
0199S19264	DC0899	7.3	40.2	0.45	1.30	2.53	1.00	0.72
0199S19265	DC0999	7.5	38.1	0.42	0.99	2.21	1.20	0.95
0199S19266	DC1099	7.5	33.0	0.40	1.19	2.15	0.88	0.69
0199S19267	DC1199	7.4	34.7	0.35	1.07	1.15	1.29	1.22
0199S19268	DC1299	7.5	27.6	0.42	1.23	1.69	1.36	1.13
0199S19269	DC1399	7.4	26.9	0.36	1.26	1.59	0.90	0.75
0199S19270	DC1499	7.2	27.6	0.41	2.27	1.07	0.85	0.66
0199S19271	DC1599	7.0	37.9	0.64	3.32	2.23	0.78	0.47
0199S19272	DC1699	7.5	21.6	0.35	1.22	1.21	0.94	0.85
0199S19273	DC1799	7.5	31.2	0.73	1.77	2.51	2.54	1.73
0199S19274	DC1899	7.4	26.1	0.44	1.72	1.92	0.95	0.71
0199S19275	DC1999	7.1	47.8	0.44	2.90	1.03	0.82	0.59

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed By:

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Client Project ID: Deer Creek Mine
Date Received: 12/07/99

Set #0199S19261
Report Date: 01/07/00

Lab Id	Sample Id	Coarse Fragments	Sand %	Silt %	Clay %	Texture	1/3 Bar %	15 Bar %
0199S19261	DC0599	0.0	10.0	56.0	34.0	SILTY CLAY LOAM	15.0	9.2
0199S19262	DC0699	0.0	22.0	43.0	35.0	CLAY LOAM	15.5	9.3
0199S19263	DC0799	6.0	16.0	52.0	32.0	SILTY CLAY LOAM	16.0	9.9
0199S19264	DC0899	5.0	44.0	27.0	29.0	CLAY LOAM	22.3	14.5
0199S19265	DC0999	1.9	12.0	56.0	32.0	SILTY CLAY LOAM	19.1	11.7
0199S19266	DC1099	0.8	36.0	36.0	28.0	CLAY LOAM	19.0	9.6
0199S19267	DC1199	0.0	22.0	36.0	42.0	CLAY	18.0	11.7
0199S19268	DC1299	21.3	26.0	42.0	32.0	CLAY LOAM	14.0	6.7
0199S19269	DC1399	0.1	36.0	38.0	26.0	LOAM	13.3	6.3
0199S19270	DC1499	19.7	56.0	24.0	20.0	SANDY CLAY LOAM	16.0	6.7
0199S19271	DC1599	0.0	28.0	42.0	30.0	CLAY LOAM	20.0	8.7
0199S19272	DC1699	2.4	60.0	19.0	21.0	SANDY CLAY LOAM	11.1	4.4
0199S19273	DC1799	0.0	17.0	64.0	19.0	SILT LOAM	18.4	6.8
0199S19274	DC1899	14.4	30.0	40.0	30.0	CLAY LOAM	16.0	5.3
0199S19275	DC1999	0.0	19.0	46.0	35.0	SILTY CLAY LOAM	28.3	13.3

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

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Client Project ID: Deer Creek Mine
Date Received: 12/07/99

Set #0199S19261
Report Date: 01/07/00

Lab Id	Sample Id	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Pot t/1000t	T.S. ABP t/1000t
0199S19261	DC0599	4.1	<0.01	0.00	270	270
0199S19262	DC0699	3.5	<0.01	0.00	115	115
0199S19263	DC0799	3.8	<0.01	0.00	323	323
0199S19264	DC0899	19.1	0.01	0.31	250	249
0199S19265	DC0999	5.3	<0.01	0.00	429	429
0199S19266	DC1099	5.0	<0.01	0.00	314	314
0199S19267	DC1199	4.9	0.05	1.56	188	187
0199S19268	DC1299	4.1	<0.01	0.00	354	354
0199S19269	DC1399	3.7	<0.01	0.00	408	408
0199S19270	DC1499	3.6	<0.01	0.00	258	258
0199S19271	DC1599	5.3	0.01	0.31	436	436
0199S19272	DC1699	2.5	<0.01	0.00	272	272
0199S19273	DC1799	3.4	<0.01	0.00	362	362
0199S19274	DC1899	3.9	<0.01	0.00	449	449
0199S19275	DC1999	7.8	<0.01	0.00	344	344

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

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Energy West Mining Co.

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Client Project ID: Deer Creek Mine
Date Received: 12/07/99

Set #0199S19261
Report Date: 01/07/00

Lab Id	Sample Id	Boron ppm	Nitrogen Nitrate ppm	TKN %	Selenium ppm	Available Sodium ppm	Exchangeable Sodium meq/100g
0199S19261	DC0599	0.27	0.60	<0.01	<0.02	0.42	0.38
0199S19262	DC0699	0.49	0.28	<0.01	<0.02	0.48	0.42
0199S19263	DC0799	0.39	0.26	0.04	<0.02	0.57	0.52
0199S19264	DC0899	0.54	0.44	0.23	<0.02	0.40	0.36
0199S19265	DC0999	0.45	0.36	0.05	<0.02	0.46	0.41
0199S19266	DC1099	0.50	0.40	0.07	<0.02	0.48	0.45
0199S19267	DC1199	0.31	0.38	<0.01	<0.02	0.50	0.46
0199S19268	DC1299	0.25	0.14	0.03	<0.02	0.39	0.35
0199S19269	DC1399	0.16	0.26	0.03	<0.02	0.40	0.38
0199S19270	DC1499	0.31	0.16	0.05	<0.02	0.48	0.46
0199S19271	DC1599	0.36	0.28	0.08	<0.02	0.43	0.40
0199S19272	DC1699	0.13	0.16	<0.01	<0.02	0.46	0.44
0199S19273	DC1799	0.42	0.38	0.03	<0.02	0.54	0.46
0199S19274	DC1899	0.27	0.20	0.03	<0.02	0.39	0.37
0199S19275	DC1999	0.34	0.26	0.16	<0.02	0.37	0.33

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

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Energy West Mining Co.
Huntington, UT

Client Project ID: Deer Creek Mine
Date Received: 12/07/99

Set #0199S19261
Report Date: 01/07/00

Lab Id	Sample Id	pH s.u.	Saturation %	EC @ 25°C mmhos/cm	Calcium meq/L	Magnesium meq/L	Sodium meq/L	SAR
0199S19276	DC2099	7.3	25.6	0.51	3.14	1.40	0.77	0.51
0199S19277	DC2199	7.5	24.9	0.39	1.22	1.43	1.12	0.97
0199S19278	DC2299	7.3	26.9	0.47	1.72	2.26	0.89	0.63

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

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Energy West Mining Co.
Huntington, UT

Client Project ID: Deer Creek Mine

Date Received: 12/07/99

Set #0199S19261

Report Date: 01/07/00

Lab Id	Sample Id	Coarse Fragments	Sand %	Silt %	Clay %	Texture	1/3 Bar %	15 Bar %
0199S19276	DC2099	5.2	37.0	41.0	22.0	LOAM	16.0	4.9
0199S19277	DC2199	5.5	21.0	51.0	28.0	CLAY LOAM	16.0	6.4
0199S19278	DC2299	0.0	38.0	36.0	26.0	LOAM	18.0	6.5

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

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Energy West Mining Co.
Huntington, UT

Client Project ID: Deer Creek Mine

Date Received: 12/07/99

Set #0199S19261

Report Date: 01/07/00

Lab Id	Sample Id	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Pot. t/1000t	T.S. ABP t/1000t
0199S19276	DC2099	5.2	<0.01	0.00	386	386
0199S19277	DC2199	4.1	<0.01	0.00	497	497
0199S19278	DC2299	6.1	<0.01	0.00	375	375

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

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Client Project ID: Deer Creek Mine
Date Received: 12/07/99

Set #0199S19261
Report Date: 01/07/00

Lab Id	Sample Id	Boron ppm	Nitrogen Nitrate ppm	TKN %	Selenium ppm	Available Sodium ppm	Exchangeable Sodium meq/100g
0199S19276	DC2099	0.29	0.50	0.07	<0.02	0.43	0.41
0199S19277	DC2199	0.27	1.38	<0.01	<0.02	0.39	0.36
0199S19278	DC2299	0.38	0.60	0.04	<0.02	0.41	0.39

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

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Client Project ID: Deer Creek Mine

Date Received: 12/07/99

Set #0199S19261

Report Date: 01/07/00

Lab Id	Sample Id	pH s.u.	Saturation %	EC @ 25°C mmhos/cm	Calcium meq/L	Magnesium meq/L	Sodium meq/L	SAR
0199S19269	DC1399	7.4	26.9	0.36	1.26	1.59	0.90	0.75
0199S19269D	DC1399	7.4	26.8	0.36	1.32	1.55	1.03	0.86
0199S19276	DC2099	7.3	25.6	0.51	3.14	1.40	0.77	0.51
0199S19276D	DC2099	7.3	25.9	0.52	3.17	1.48	0.82	0.53

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

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Client Project ID: Deer Creek Mine

Date Received: 12/07/99

Set #0199S19261

Report Date: 01/07/00

Lab Id	Sample Id	Coarse Fragments	Sand %	Silt %	Clay %	Texture	1/3 Bar %	15 Bar %
0199S19269	DC1399	0.1	36.0	38.0	26.0	LOAM	13.3	6.3
0199S19269D	DC1399		35.0	40.0	25.0	LOAM	13.7	6.2
0199S19276	DC2099	5.2	37.0	41.0	22.0	LOAM	16.0	4.9
0199S19276D	DC2099		36.0	40.0	24.0	LOAM	15.4	5.0

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

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Client Project ID: Deer Creek Mine

Date Received: 12/07/99

Set #0199S19261

Report Date: 01/07/00

Lab Id	Sample Id	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Pot. t/1000t	T.S. ABP t/1000t
0199S19269	DC1399	3.7	<0.01	0.00	408	408
0199S19269D	DC1399	3.7	<0.01	0.00	414	414
0199S19276	DC2099	5.2	<0.01	0.00	386	386
0199S19276D	DC2099	5.3	<0.01	0.00	382	382

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

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Client Project ID: Deer Creek Mine
Date Received: 12/07/99

Set #0199S19261
Report Date: 01/07/00

Lab Id	Sample Id	Boron ppm	Nitrogen Nitrate ppm	TKN %	Selenium ppm	Available Sodium ppm	Exchangeable Sodium meq/100g
0199S19269	DC1399	0.16	0.26	0.03	<0.02	0.40	0.38
0199S19269D	DC1399	0.22	0.26	0.02	<0.02	0.37	0.34
0199S19276	DC2099	0.29	0.50	0.07	<0.02	0.43	0.41
0199S19276D	DC2099	0.22	0.44	0.07	<0.02	0.40	0.38

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed By: ______________________

Joey Sheeley
Soils Lab Supervisor

340. Reclamation Plan (R645-301-300)

R645-301-341: Revegetation

Table 3-1 discloses the timetable in which reclamation will be conducted on Deer Creek Mine facilities. Much of the operations will be conducted simultaneously. The main emphasis of reclamation will work from the top of the canyon to the bottom.

Table 3-2 establishes a monitoring program that extends through the responsibility period of the bond.

Table 3-1: Deer Creek Coal Mine Reclamation Schedule: Initial Reclamation for mine facilities.

#	Project	Estimated Scheduling *
1	Soil Sampling (2001/2002)	Sampling conducted between the months of June - October.
2	Structure Removal	
3	Closures – Portals & Ventilation**	
4	Soil Salvaging	
5	Hauling, Backfilling, Compaction & Grading	
6	Install Riprap Channels	
7	Seed Bed Preparation	
8	Fertilization & Mulching	
9	Seeding & Planting	
10	Sediment Control Structure Removal ***	

* After reclamation plan approval, a reclamation cost estimate will be developed that will give an accurate time duration of each project listed.
** Portals in Deer Creek Canyon may not be sealed at the same time as the portals outside the Deer Creek facility. This timetable illustrates the order and sequence in which projects will occur.
*** The sediment pond will be removed at the completion of all other reclamation activities above pond.

Notice in the table above that backfill and grading activities and seeding activities are occurring simultaneously. This will occur as work progresses down canyons. Advantageously, seeding will occur during the fall season. However, if recontouring is completed in the spring of the year on the upper portions of the disturbed area, seeding will follow. Live tree and shrub plantings will occur in early spring.

Table 3-2: Deer Creek Coal Mine Reclamation Schedule: 1st thru 10th Year.

#	10 Year Revegetation & Monitoring	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year	9th Year	10th Year
1	Plant Monitoring Disease & Pest Control *		✔ ✔	✔ ✔	✔ ✔	✔ ✔	✔ ✔	✔ ✔	✔ ✔	✔ ✔	✔ ✔
2	Mine Water Discharge Monitoring**	✔	✔	✔	✔	✔ ✔***	✔	✔	✔	✔ ✔***	✔
3	Soil Stabilization Rills & Gullies		✔	✔	✔	✔	✔	✔	✔	✔	✔
4	Contingent Seeding		✔			✔					
5	Revegetation Inventory for Bond Release				✔				✔	✔	✔

* Monitoring is conducted twice per year during the spring and fall.

** Monitoring of mine discharge will be conducted as required by the current UPDES permit. Surface water surveys conducted to identify any new discharge locations within or below sealed portals.

*** Baseline sampling conducted during 5th and 9th year. In no case will baseline sampling time frame exceed 5 years converting from operational to reclamation monitoring. (See Volume 9, Appendix A)

Description of Revegetation Operations

In tables 3-3, 3-4, and 3-5, seed mixes have been established for three areas of disturbance; Pinyon Juniper, Riparian, Conifer habitats. Pinyon Juniper habitats are those areas that have a high exposure to sunlight. These areas are typically drier and need grass growth early on for moisture retention and soil stabilization.

Riparian areas are seeded to encourage forb and shrub growth, which supplies a good food source and cover for wildlife. These areas usually have a sufficient water supply for competent plant growth.

Table 3-3: Seed Mixture (Pinyon-Juniper)

Common Name	Scientific Name	Lbs/Acre Equivalent PLS*
Grasses		
Bluebunch Wheatgrass	Agropyron spicatum	1.0
Big Bluegrass	Poa ampla	0.5
Great Basin Wild Rye	Leymus cinereus	2.0
Indian Ricegrass	Oryzopsis hymenoides var. Paloma	3.0
Thickspike Wheatgrass	Agropyron dasystachyum var. Critana	2.0
Western Wheatgrass	Agropyron smithii var. Rosanna	3.0
Forbes		
Blueleaf Aster	Aster glaucodes	0.5
Blue Flax	Linum lewisii	1.0
Louisiana Sage	Artemisia ludoviciana	0.2
Northern Sweetvetch	Hedysarum boreale	1.0
Palmer Penstemon	Penstemon palmeri	0.5
Shrubs		
Big Sagbrush	Artemisia tridentata var. wyomingensis	0.5
Curleaf Mahogany	Cercodarus ledifolius	2.0
Fourwing Saltbush	Atriplex canescens	3.0
Saskatoon Serviceberry	Amelanchier alnifolia	1.0
Whitestem Rubber Rabbitbrush	Chrysothamnus nauseosus	0.2

Table 3-4: Seed Mixture (Riparian)*

Common Name	Scientific Name	Lbs/Acre Equivalent PLS*
Grasses		
Indian Ricegrass	Oryzopisi hymenoides var. Paloma	2.0
Kentucky Bluegrass	Poa pratensis	1.0
Mountain Brome	Bromus marginatus	2.0
Needle and Thread Grass	Stipa comata	1.0
Streambank Wheatgrass	Agropyron riparium var. Sodar	3.0
Forbs		
Blueleaf Aster	Aster glaucodes	0.2
Louisiana Sage	Artemisia ludoviciana	0.2
Rocky Mountain Penstemon	Penstemon strictus	1.0
Silky Lupine	Lupinus sericeus	3.0
White Yarrow	Achillea millefolium	0.1
Shrubs**		
Saskatoon Serviceberry	Amelanchier alnifolia	1.0
Rocky Mountain Maple (C) or (B)	Acer glabrum	300/acre within 20 ft of stream
Woods Rose (C) or (B)	Rosa woodsii	200/acre within 20 ft of stream
Trees**		
Coyote Willow (X) or (RX)	Salix exigua	One foot spacing
Red Osier Dogwood (X) or (RX)	Cornus stolonifera	Five foot spacing
Narrowleaf Cottonwood (C) or (P)	Populus angustifolia	Ten foot spacing

* (C) = Containerized plants (B) = Bare root plants (X) = Cuttings (RX) = Rooted cuttings (P) = Poles
** 25% of live Trees and Shrubs will be planted yearly up to the 4th year. Planting will take place in early spring between the months of March and April.

Mixed conifer areas are normally north facing slopes. These areas receive less sunlight and are usually wetter. An initial growth of grasses is needed to provide soil stabilization. Shrubs do well in these area which provide food and cover for wildlife.

Table 3-5: Seed Mixture (Mixed Conifer)

Common Name	Scientific Name	Lbs/Acre Equivalent PLS*
Grasses		
Bluebunch Wheatgrass	Agropyron spicatum	1.0
Indian Ricegrass	Oryzopisi hymenoides var. Paloma	2.0
Western Wheatgrass	Agropyron smithii var. Rosanna	3.0
Kentucky Bluegrass	Poa prognsis	1.0
Mountain Brome	Bromus marginatus	2.0
Slender Wheatgrass	Elymus trachycaulus ssp. trachycaulus	2.0
Forbs		
Louisiana Sage	Artemisia ludoviciana	0.2
Northern Sweetvetch	Hedysarum boreale	1.0
Pacific Aster	Aster chilensis	0.2
Rocky Mountain Penstemon	Penstemon strictus	1.0
Silky Lupine	Lupinus sericeus	1.0
Shrubs		
Mountain Big Sagebrush	Artemisia tridentata vaseyana	0.2
Saskatoon Serviceberry	Amelanchier alnifolia	2.0
Skunkbush Sumac	Rhus trilobata	1.0
Trees		
White Fir	Abies concolor	250/acre
Douglas Fir	Psuedotsuga menziessi	250/acre

Seeding Techniques

Seeding will take place as contemporaneously as practical following soil placement, contouring/pocking, and fertilization of the area being reclaimed. Certified noxious weed free alfalfa hay will be incorporated into the soil following contouring at a rate of 2000lbs/acre. Fertilizer will be applied at the following rate:

Ammonium Nitrate 40lbs/acre

Triple Superphosphate 35lbs/acre

Pocking techniques will mix the alfalfa and fertilizer into the upper portion of the soil.

The seed mixture will be broadcast using a "hurricane spreader" or applied using a hydroseeder. If the seed mixture is hydroseeded, a small amount of wood fiber mulch will be added to mark the area of coverage during application.

Next, a certified noxious weed-free straw mulch will be applied at a rate of 2000lbs/acre. If possible, the mulch will be applied using a tub grinder or similar blower. A tackifier (plantago or other similar tackifier) will be applied at a rate of 500 lbs/ac to cover the mulch and stabilize the soil. Mulch and tackifier will be applied as contemporaneously as possible.

Riparian seed mixtures will be applied to an area that is within 20 feet either side of the riprap channel of the Deer Creek Canyon, Deer Canyon, and Elk Canyon drainage systems. Conifer seed mixtures will be applied to north facing slopes while Pinyon-Juniper seed mixtures will be applied to all other areas of the reclamation site. A color-coded revegetation location map (Drawing DS-1797-D) is provided in **Appendix R645-301-300-A**.

Measures to determine success of revegetation are those included in R645-301-350 of the Utah Coal Rules.

R645-301-342: Fish and Wildlife

In the slope areas of less than 5% along the Deer Creek, Deer and Elk drainage (review **R645-301-700: Hydrology** and refer to map DS-1780-D - *Final Reclamation Hydrology Map*), channel design will incorporate soft bioengineering. Instead of the use of riprap to protect channel bed and bank from eroding, alternative instream controls will be utilized. These alternatives include wing deflectors using log litter or riprap piles to direct flow in a meandering fashion and away from the bank; boulder clusters to provide cover, create scours and reduce velocity; "U" and or "V"shaped weirs that will create backwater and facilitate sedimentation. Vegetation will be established on the channel bottom.

The channel bank in these areas will be protected primarily with vegetation. In transition areas of the channel (e.g. from a 10% slope to a 2% slope), the bank will be heavily armored. A energy dissipation basin is designed at the toe of the Deer Creek and Deer canyon drainage slopes. By design, a hydraulic jump will form at the bottom of these slopes. The location and depth of the jump is calculated in **Appendix R645-301-700-B**. Cross-sectional design drawings are also located in this appendix.

Shrubs within the riparian area were chosen to provide cover and forage for wildlife. They will be hand planted using a shovel. Care will be taken not to damage the root structures of bare rooted plants. Containerized plants will be planted similarly. During the first year of reclamation, 25% of the total trees and shrubs will be planted during early months of spring. Each year, an additional 25% will be planted (in spring) until 100% of all trees and shrubs have been planted. The trees and shrubs will be planted randomly in areas that have adequate moisture or moisture collecting features. Monitoring will be performed throughout each year to track the success or failure of the plantings. Planting and/or fertilization procedures may change periodically to improve success rates in order to achieve bond release.

The riparian seed mix will be used as mentioned in Table 3-4 to provide a riparian habitat along the stream banks for wildlife cover and food. The seed will be dispersed in the constructed channel and within 20 feet of both sides of the channel.

R645-301-350: Performance Standards

Signs will be placed around the planted slopes for there protection. The area will be entered only to provide maintenance (as needed) and/or monitoring duties.

Weed control will not be undertaken unless it is determined necessary due to weed dominance and delayed rate of succession. All noxious weeds will be eradicated either chemically or physically if they become established on the site.

Rodent damage on revegetated areas will be assessed during monitoring periods. Species specific control measures will be implemented as necessary.

Annual monitoring will also include inspection for rills and gullies. Should these be present, they will be filled and the soil reseeded. Rill and gully repair will follow the regulations set forth in the Coal Rules R645-301-357.360 through R645-301-357.365. As repairs are recognized, the Division will be notified and the affected area will be reported in the annual vegetation report.

All vegetation sampling will be undertaken in the late summer for maximum plant growth. The line intercept or ocular estimation methods will be used to measure cover and species composition. The point-center quarter method will be used to measure shrub and tree density.

Productivity measurements will be a double sampling procedure of clippped plots and ocular estimates. Rectangular plots (6.27 in. x 100 in.) will be randomly located in reference areas and revegetation sites. Sampling will be at the 90% confidence level.

The reference area will be checked to detect any change from natural or man-induced activities and to verify they are in fair or better condition. Sampling of the reference sites at the time of bond release will be conducted concurrently with final reclamation sampling, using the same methodology used to sample the reclaimed areas.

The standards for success to be applied for ground cover and production of living plants on the reclaimed areas at the Deer Creek Mine will be at least equal to 90% (with a 90% confidence level) to that of the respective reference area at the time of bond release. For example, the reclaimed riparian area will be compared to the riparian reference area for cover and production. Cover in the reclaimed areas will not be less than that required to achieve the approved post-mining land use outlined in **R645-301-400: Land Use and Air Quality**.

Revegetation for tree and shrub species will be considered successful when the tree and shrub count in the reclaimed areas are similar at the time of bond release to the count in the reference area.

During the 4^{th} year after revegetation, the point-quarter or other accepted method will again be used to determine the density of trees and shrubs in the reclaimed areas. Locations of monitoring will be random within each of the reclaimed areas and recorded. The final 25% of the tree and shrub live plantings will be included in the 4^{th} year density counts. This process will be repeated in the 8^{th} year.

At the time of bond release, or after the 10 year responsibility period has passed, similarity between the reclaimed area and corresponding reference area will compare life forms and/or species present in each community by the use of similarity indices. Indices of similarity provide the means of mathematically comparing the plant communities in the two areas. One of, or a combination of the three indices found in the Vegetation Guidelines, Appendix B will be used to determine the similarity between the reclaimed and reference area. If another index (or combination thereof) is used, Division approval will be required. Similarity will be considered successful when the index value is at least 70% of the reference area.

All vegetation monitoring data will be reported annually. This report will contain a narrative of the actual monitoring methods used, results, and a discussion of the overall success or failure of each area. Raw data sheets will also be included in the annual reports. Standards attained at the time of bond release will be approved by the Division of Wildlife Resources (DWR) and the Division of Oil, Gas and Mining.

The Revised Universal Soil Loss Equation (RUSLE) is used to model sediment loss from disturbed/reclaimed areas. Program parameters are discussed in **R645-301-700: Hydrology**. Monitoring of sediment will occur at monitoring points setup above and below the disturbed area of the Deer Creek Mine. This information will be reported annually.

PACIFICORP

ENERGY WEST MINING

Deer Creek Mine
C/015/018
Mining and Reclamation Plan

Appendix R645-301-300-A

Vegetation Community Locations: Drawing DS-1797-D

540. Reclamation Plan (R645-301-540)

R645-301-541: General

As required by R645-301-540, the applicant intends to conduct final reclamation as follows:

1. Remove existing structures.
2. Remove buried diversion systems, where necessary, and provide 100yr/6hr storm event channels.
3. Re-contour the disturbed area to blend in with the existing surroundings.
4. Stabilize all fill structures.
5. Reduce sediment loading to receiving streams by incorporating Best Management Practices (BMP's).
6. Vegetate all disturbed areas to meet minimum requirements of plant cover, diversity and production as compared to the reference areas.
7. Meet the stated post-mining land use.
8. Achieve bond release.

A typical cross-sectional drawing displaying the sequence of reclamation is found in **Appendix R645-301-500-A**.

R645-301-541.300: Structure Removal

Following the completion of mining, work will begin on the demolition of surface facilities. All structural steel, metal siding and other building materials except concrete will be dismantled and disposed of off the permit area. These structures include, but are not limited to:

1. Fan and fan housing
2. Water tanks
3. Fuel storage tanks
4. Substations
5. Oil storage facilities
6. Belt structures
7. Fences
8. Office/Warehouse systems
9. Crusher Plant

All foundations and structures built of concrete will be broken up and buried in the reclaim bin as shown in the cross-sections of Drawing DS-1784-D, **Appendix R645-301-500-C**. There is approximately 5666 yds^3 of in-place concrete at the Deer Creek Mine. It is estimated that the density for in-place concrete is approximately 150 lbs/ft^3. For crushed concrete, the estimated density is approximately 110 lbs/ft^3. The volume needed to backfill crushed concrete increases about 27% using these density estimations to 7726 yds^3. The reclaim bin will have ample room to bury all demolished concrete during this sequence of reclamation. Any excess demolition material, will be used as fill against cut slopes where needed and/or taken to the waste rock site for disposal. The asphalt material from the road and parking lot will be excavated and taken to a permitted class IV landfill. For cut and fill quantities, refer to drawings in **Appendix R64-301-500-C**.

R645-301-542: Narratives, Maps and Plans

A detailed timetable for the completion of each major step in reclamation is outlined in **R645-301-300: Biology**, Table 3-1. Pre-reclamation surface configurations for the Deer Creek Mine in Deer Creek Canyon, Rilda Canyon, North Meetinghouse Canyon are located in **Appendix R645-301-500-A**. These drawings show the location and extent of surface disturbances due to coal mining and reclamation activities of the Deer Creek Mine, refuse pile locations, and highwall areas. The surface disturbance associated with the 9th East Portals in Grimes Wash was reclaimed in 1999, The reclamation of this area is discussed in **Appendix R645-301-500-B**.

A detailed plan for backfilling, soil stabilization, compacting and grading is outlined below in R645-301-553, Backfilling and Grading. Certified contour maps, cross-sections, and soil placement maps are attached in **Appendix R645-301-500-C**.

550. Reclamation Design Criteria and Plans (R645-301-550)

Reclamation activities at the Deer Creek Mine will include plans and designs for 1) Casing and sealing of portals, 2) Permanent features, and 3) Backfilling and grading. These plans and designs are outlined below.

R645-301-551: Casing and Sealing of Underground Openings

Deer Creek has a total of sixteen (16) portal locations of which one (1) is an exhaust shaft. These portals are located as outlined in Table 5-1.

Table 5-1: Portal locations of the Deer Creek Mine.

	Intake	Belt	Exhaust	Shaft
Deer Creek Canyon	4 portals total, 2 sealed and backfilled	1 portal	3 portals total, 1 old exhaust 2 sealed & backfilled	1 portal (fan portal)
North Fork Meetinghouse Canyon (Refer to 9th East North Meetinghouse Reclamation Plan)	2 portals			
Grimes Wash Canyon (Refer to 9th East Grimes Wash Reclamation Plan)	3 portals, all sealed (Reclaimed Fall/99)			
Rilda Canyon (Refer to Rilda Cyn Reclamation Plan)	1 portal		1 portal	

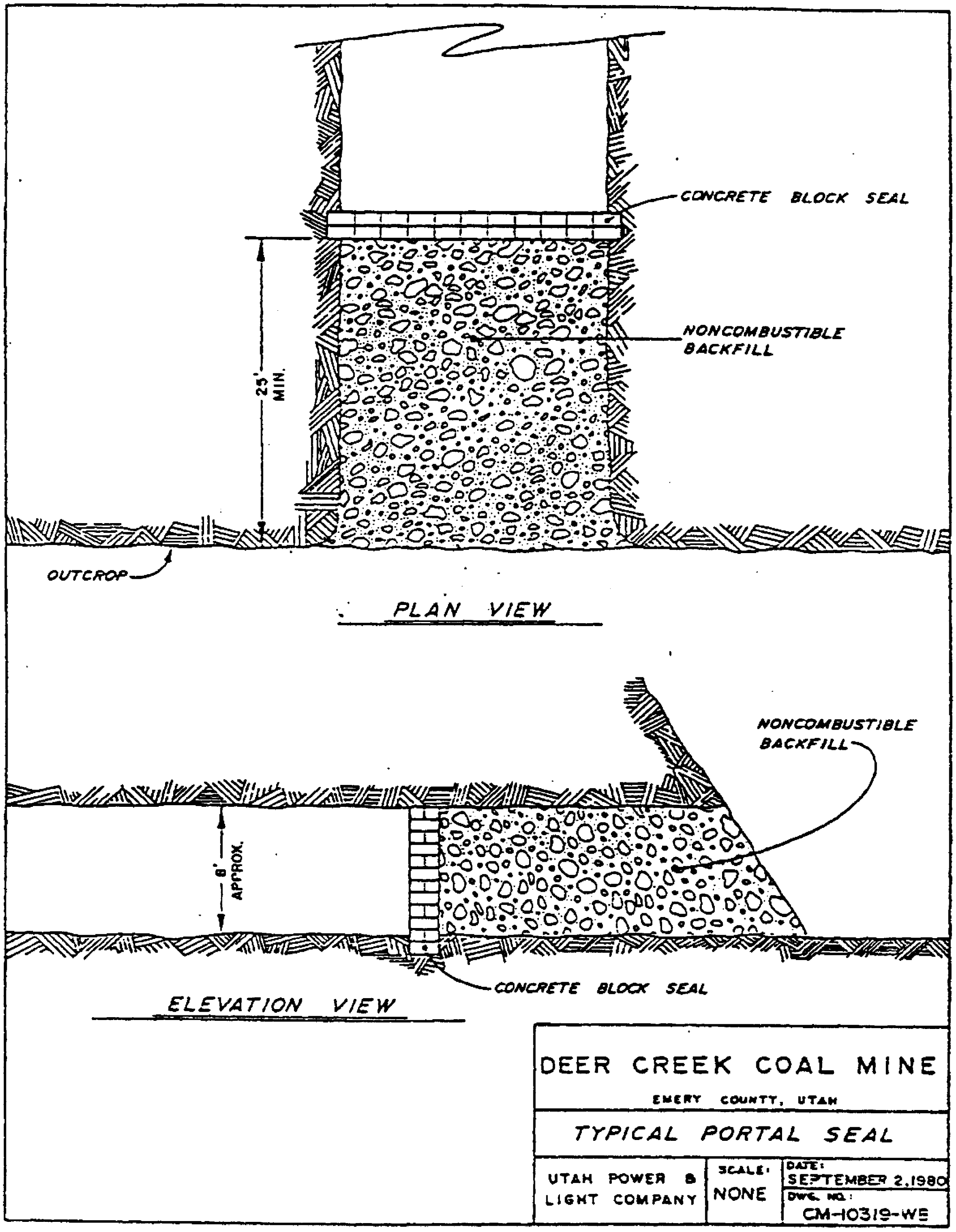

Figure 5-1: Typical portal seal diagram

The plan for sealing these portals consists of permanent double-block seals with at least 25 feet of non-combustible material compacted, to the extent possible, to form an earthen plug (see Figure 5-1). Of the 16 portals, only 2 (Rilda Canyon) are considered post-SMCRA portal highwalls. Highwall elimination of these portals is discussed in **Appendix R645-301-500-D**, where a **highwall elimination plan is** presented for all pre- and post-SMCRA portals. Complete reclamation plans/discussion for the 9th East portals in the North Fork Meetinghouse Canyon are attached in **Appendix R645-301-500-B**. The Rilda Canyon and 9th East Grimes Wash (reclaimed fall '99) portal reclamation plans are attached in **Appendix R645-301-500-B**. The portals in Deer Creek Canyon are discussed below.

Deer Creek Intake Portals and Belt Portal

Listed in Table 5-2 are the elevations of the Deer Creek portals and elevations of major areas in the mine that will either direct mine water or act as a barrier.

Table 5-2: Elevations of various areas of the Deer Creek Mine.

Location	Elevation (approx. ft.)
Intake and Belt Portals	**7460**
1st south Dump Point (raise bin)	7521
Pleasant Valley Fault Crossings	7545 (top), 7415 (bottom)
Main West – 3rd North Intersection	7525
3rd North – 9th East Portals (Meetinghouse)	7600
9th East (Wilberg) Portals	7771
Rilda Canyon Portals	7941
Old McKinnon Portals	7500

All portals (except for the Deer Creek Canyon intake portals) are located up-dip from the mined-out entries eliminating the need for hydrological seals or provisions for providing water escapements. The Deer Creek intake and belt portals, however, would be difficult to keep water from migrating though the fractures around hydrologic seals if they were to be used after mine abandonment. The applicant feels that the most environmentally effective method would be to establish a permanent discharge in the north intake portal nearest Deer Canyon. The quality of the water that would be discharged could meet the EPA effluent limitations without treatment.

Upon mine abandonment, the intake portals in Deer Creek Canyon, which are the lowest elevation of all the portals of the Deer Creek Mine, will be sealed 25 feet inby the opening. One mine entry (as mention above) behind the seal will be filled with gravel and sand for a distance of 25 feet to act as a filter to remove any suspended solids from the water. Four, six (6) inch diameter drain pipes will be installed, which will allow for a continuous discharge. The pipes will direct collected mine water through the seal into a french drain system that will direct mine water toward the surface. The french drain will consist of a 1 1/2 foot deep layer of 6" gravel covered with incrementally smaller gravel to a depth of 3 feet. Non-combustible backfill material will be placed in the mine opening and used to fill the empty space that remains outby the seal to the surface. Drawing DS-1780-D, 5 of 5, in **Appendix R645-301-700-B**, illustrates the design of the mine water discharge. The mine water will discharge to the surface and route through a lightly riprapped impression to the Deer drainage. The water will then flow freely down the reclaimed drainage.

After the portals are sealed and mine water begins discharging, the applicant will monitor the water quality parameters listed in the UPDES permit for the Deer Creek Mine. The samples will be collected, analyzed, and reported as required by the permit. Surface water sites will be monitored for baseline parameters during the fifth (5^{th}) and ninth (9^{th}) years after final reclamation. In no case will baseline sampling time frame exceed 5 years converting from operational to reclamation monitoring. The applicant also commits to conduct annual surveys to identify any new discharge locations within and below sealed portals. If discharge occurs, one water sample will be collected and analyzed per location quarterly. Parameters analyzed are those listed in the DOGM Guidelines for Groundwater Water Quality (see Table #2, Appendix A, Volume 9, Hydrologic Section).

9^{th} East Portals - North Meetinghouse Canyon

The 9^{th} East portals in North Meetinghouse Canyon will be reclaimed at a time when they are no longer needed. This does not necessarily coincide with the Deer Creek Mine cessation and therefore, is not added into the reclamation timetable. The reclamation plan for these portals can be reviewed in **Appendix R645-301-500-B**.

9^{th} East Portals - Grimes Wash

The 9^{th} East portals in Grimes Wash were reclaimed in the fall of 1999. Refer to **Appendix R645-301-500-B** for a complete report and discussion of the reclamation operation.

Rilda Canyon Portals

The Rilda Canyon portals reclamation plan was added to the Deer Creek MRP in 1995 as a "stand alone" plan. Although the portals and surface facilities are part of the Deer Creek Mine, the reclamation plan for the area was developed as a separate section within the MRP. The permittee intends to keep this plan as a separate section. This plan can be reviewed in **Appendix R645-301-500-B**.

Deer Creek Waste Rock Site

Refer to Volume 10, Chapter III for the reclamation plan for the Deer Creek waste rock site.

R645-301-553: Backfilling and Grading

Once the structures have been removed and the portals sealed as outlined in Figure 5-1, backfilling and grading will commence. Reclamation will be accomplished by systematically reclaiming the Deer Creek, Deer, and Elk canyons starting at the uppermost part of the disturbed area, working down. Various stages of the reclamation process will be occurring simultaneously in different parts of the site. Working from top to bottom will minimize handling and compaction of the material in the reclaimed areas and allow the sedimentation structures below the reclamation work to remain in place. As mentioned in **R645-301-200:Soils**, a substitute topsoil material will be excavated from the existing undisturbed drainage corridor. This material will be taken from between stations between 9+00 - 15+00 and 24+00 - 30+00 (refer to map DS-1782-D in **Appendix R645-301-500-C**). Segregation and placement of the substitute material will take place as contemporaneously as possible to limit minimize handling. There is an estimated quantity of 58,891.08 yds^3 of substitute topsoil material that can be used as a growth media. Depth over the proposed soil placement areas will be approximately 2 ¼ feet. Drawing DS-1816-D illustrates the locations of substitute subsoil and topsoil placement.

The permittee feels that in the case of a storm event, runoff from the disturbed areas will flow down gradient to a remaining sediment control structure. At this point, the sediment will be treated at the structure using strawbales, sediment traps, etc, and/or be routed to the sediment pond. Routing will utilize berms and/or ditches to direct flow (refer to Figure 7-4A in **Appendix R645-301-700-B**). Channel construction, mulching, pocking, fertilization, and seeding will occur contemporaneously with backfilling and grading as work progress down each canyon. Seeding and planting is covered in **R645-301-300: Biology**. The reclamation descriptions below refer to Drawings DS-1782-D, DS-1783-D (1 of 2, 2 of 2) and DS-1784-D in **Appendix R645-301-500-C**. The referred drawing contain plan and cross-sectional views of the reclamation area.

Deer Creek Canyon (Upper – stations 32+00 through 21+00)

Reclamation will begin between stations 32+00 and 31+00 by first removing the concrete inlet structure and inlet screen. The concrete inlet will be broken up and used as fill while the inlet screen will be disposed of off-site. The area above the concrete inlet will be excavated for tree revetment construction. The revetments will be placed in the banks to transition the channel from natural to reclaimed.

The 8.0 foot diameter culvert will be removed in sections (length will be determined by contractor at time of extraction) and the channel reestablished to its approximate original position. Although the Deer Creek drainage is classified as an ephermal drainage, extended flows typically occur. The spring flow that is present within the drainage will be diverted around the reclamation work and back into the culvert below the work area. This diversion will be accomplished using a 12" flexible culvert or other suitable device. The undisturbed channel will be diverted above the concrete inlet into the flexible culvert by means of a berm, dam, or other diversion system. The flexible culvert will be routed around the area to be reclaimed along the contour. The diverted drainage will enter back into the undisturbed culvert below the reclamation work. At the completion of each section, roughening, mulching, and seeding will be conducted prior to removing the next section of undisturbed culvert. Flow will be routed back into the newly riprapped channel after all other work is completed. As each successive section is reclaimed, flow in the channel will be diverted in the same methods described above. The average grade between stations 32+00 and 21+00 is 25%. Channel sizing and design is discussed in **R645-301-700: Hydrology**.

Substitute topsoil will be excavated along the undisturbed culvert as the culvert is removed and placed as illustrated on Drawing DS-1816-D in **Appendix R645-301-500-C**. Refer to **R645-301-200: Soils** for the discussion on substitute top and subsoil material As work progresses down the canyon to the water tank pad and fan pad (between stations 30+00 and 27+00), the berm material will be used to contour the areas of each pad. The outslope of the fan pad will be cut to reduce the gradient of this slope. A slope stability analysis was conducted in April of 2000 by RB&G Engineering. See report in **Appendix R645-301-500-E.** The material will be used on the pad to fill against the pad cut. The ventilation shaft will be backfilled using crushed concrete structure material and any other available material. This portal shaft is considered a pre-SMCRA highwall. **Appendix R645-301-500-D** details highwall elimination of all Deer Creek portals. Slope stability analysis on this slope is presented later in this chapter.

A ground water seep occurs in the location of the fan pad. A french drain will be constructed to route the water into the Deer Creek drainage. A typical french drain design is outlined on drawing DS-1780-D, 5 of 5. Location of the french drain is found on drawing DS-1780-D, 1 of 5. These Drawing can be reviewed in **Appendix R645-301-700-B**.

All other drainage culverts, water lines, fuel lines (empty), etc., that affect contouring during reclamation operations, will be removed and disposed of off-site. Disturbed runoff drainage controls will be maintained. Control structures below reclamation work will remain intact to treat any runoff that might occur.

Using the berm material, the road cuts accessing the fan pad will be graded and contoured to blend in with the surrounding topography. Many vegetal species (i.e. conifers and shrubs) have established in the upper disturbed areas of the Deer Creek Canyon. The permittee intends to retain as much established vegetation as possible. The area will be deep gouged (pocked) using the bucket of a track-hoe or similar machinery. Pocks will be created (approximately 3.0'diameter x 1.5' deep) to minimize (or eliminate) erosion and sediment transport.

An estimate of soil loss from erosion is made using the revised universal soil loss equation (RUSLE). RUSLE is an erosion model designed to predict the long term average annual soil loss carried by runoff from specific slopes in specific management systems. A complete discussion of estimated soil loss is found in **R645-301-700: Hydrology**.

The upper portion of Deer Creek Canyon will be contoured as outlined on the final reclamation map (Drawing DS-1783-D of **Appendix R645-301-500-C**). Approximately 38,522.31 cubic yards of material will be cut and 32,478.15 cubic yards will be filled in this portion of the canyon to accomplish the desired contour.

<u>Deer Canyon</u>

Reclamation will begin in the upper elevations (station 4+00, Drawing DS-1784-D of **Appendix R645-301-500-C**) of Deer Canyon while systematically working down the canyon to station 0+00. Since the Deer Canyon is ephemeral and flows are rare, the two (2) culverts (one 54" and one 36") will be removed without any diversion structure. If a storm event occurs during the reclamation activities in this canyon, runoff will be diverted to the drop inlet at station 16+00 in the Deer Creek Canyon. The runoff will be treated with straw bales or other control structure and routed into the drop inlet where it will report to the sediment pond. The concrete inlet will be broken up and used as fill. The inlet screen and culvert material will be hauled off-site and disposed. The area above the concrete inlet will be excavated for a boulder revetment construction. The revetments will be secured along the banks to transition the channel from natural to reclaimed.

A designed riprapped channel will be constructed as shown on Drawing DS-1780-D in **Appendix R645-301-700-B**. From station 2+43 to the confluence with the Deer Creek channel (refer to above mentioned drawing), a soft bio-engineered channel will be incorporated. This idea is discussed in <u>R645-301-342 - Fish and Wildlife</u>. A complete channel design is found in **R645-301-700: Hydrology**.

The canyon will be contoured as outlined on final reclamation map Drawing DS-1782-D in **Appendix R645-301-500-C**. Approximately 2761.26 cubic yards of material will be cut, and approximately 5845.00 cubic yards will be filled to accomplish the desired contour (see mass balance table on same drawing). Sufficient substitute soil material will be used in as needed. The reclamation plan will follow the processes outlined in <u>R645-301-233 Topsoil Substitutes and Supplements</u> to achieve a sufficient planting medium. The area will be deep gouged (pocked) using the bucket of a track-hoe or similar machinery. Pocks will be created (approximately 3.0' diameter x 1.5' deep) to minimize erosion and sediment transport.

Deer Creek Canyon (Mid – stations 21+00 through 8+00)

Reclamation will proceed at station 21+00 to station 8+00 in the Deer Creek Canyon. Removal of the 8'dia. culvert will continue in this area. Water within this channel will be diverted as previously described. The channel between 21+00 and 17+00 will utilize soft bio-engineering techniques to influence the development of a riparian habitat and encourage sediment deposition in slow moving waters. Refer to **R645-301-700: Hydrology** for a complete discussion and design. The remainder of the channel in this section will be riprapped according to sizing specification outlined in **R645-301-700: Hydrology**.

Suitable substitute topsoil will be separated and placed/stored as outlined on drawing DS-1816-D in **Appendix R645-301-500-C**. This soil will be used in areas where lesser quality soils exist and/or used as cover over the slope of the refuse pile in Deer Creek Canyon.

The outslope of the material storage yard will be excavated and used as fill along the yard parameter. The outslope of the refuse will also be excavated and used as fill in these areas. This will create a slope of less than 2:1. A slope stability analysis was conducted in April of 2000 by RB&G Engineering. See report in **Appendix R645-301-500-E.** The location of this area is outlined on Drawing DS-1796-D.

The final reclamation work in this section will involve cutting and filling to match the cross-sections in Drawing DS-1783-D of **Appendix R645-301-500-C**. Approximately 91,231.19 cubic yards will be cut and 71,425.90 cubic yards of fill material will be used to contour the area. The road will be roughened and blended into the slope of the refuse pile to the north, and the Deer Creek channel to the south. The surface will be pocked to control erosion and enhance vegetation growth. The reclamation plan will follow the processes outlined in R645-301-233 Topsoil Substitutes and Supplements to achieve a sufficient planting medium. Rock, deadfall and other natural material will be incorporated to improve micro-habitats and visual appearance. The area will be mulched and seeded to complete the work in this area.

Elk Canyon

Beginning in Elk Canyon, above station 6+00, the concrete inlet structure and inlet screen will be removed. The concrete inlet will be crushed and used as fill. The screen will be disposed of off site. The 30 inch culvert will also be removed and disposed of off site. The area above the concrete inlet will be excavated for tree revetment construction. The revetments will be placed in the banks to transition the channel from natural to reclaimed. Two other undisturbed inlets occur in Elk Canyon and will be removed in a similar process. No water diversion will be needed in this canyon since only ephemeral flow occurs.

In the case that a storm event occurs, rainfall runoff will be diverted around the reclamation to remaining undisturbed culverts. The topography in this canyon is such that surface flow drains toward the sediment pond. The pond will settle any sediment from the runoff before reaching the natural canyon channel.

Cuts will be made to establish the channel as outlined on drawing DS-1784-D. Approximately 12,586.04 cubic yards of material will be cut and 22,783.79 cubic yards of fill will be needed to contour the area. There is approximately 4006.11 cubic yards of spoil material stored southeast of the coal bin. This material will be used to contour the disturbed area as shown on map DS-1782-D and DS-1784-D, 1 of 1. The material in this pile will be sampled as outlined in **R645-301-200: Soils** to determine suitability as fill material. The results of the analysis will determine the depth of substitute soil (if needed) to be placed over this fill material. The channel will be sized, developed, and riprapped according to the specifications outlined in **R645-301-700: Hydrology**. The ephemeral draws in this canyon will be transitioned into the main Elk Canyon reclaimed channel.

The surface area will be pocked to enhance soil erosion control and vegetation. Rock and other natural material will be blended with the reclaimed area to improve visual appearance and control erosion. The area will be mulched and seeded to complete the work in this area.

Deer Creek Canyon (Lower – stations 8+00 through 0+00)

The final section begins at station 8+00. Below this station, the Deer Creek drainage and the Elk Canyon drainage converge. The 8.0 foot diameter culvert will be removed to approximately station 6+00. The culvert will be disposed of off site.

A check dam or similar device will be placed down stream to encourage sediment deposition in the undisturbed channel. This control structure will act as the final treatment while the sediment pond is being removed. Typical designs are presented on 7-4A in **Appendix R645-301-700-B**. The structure will be removed following the completion of reclamation at the Deer Creek Mine.

The sediment pond will be filled using the material that makes up the dam and other side slopes in the area. The material will be compacted to eliminate the possibility of settling. The Deer Creek channel will be routed along the southern cut wall of the sediment pond. This will create an esthetically pleasing natural view as the channel passes through this area. The channel will be riprapped 32.0 feet past station 1+00 where it will then be blended into the existing undisturbed channel. Refer to Figure 7-1A for typical channel transition cross-sections in **Appendix R645-301-700-B**.

During the sediment pond demolition and channel construction, the Deer Creek channel will be diverted from the confluence of the Deer Creek and Elk Canyon channels along the contour to the existing 8' culvert. After construction activities, flow will be routed into the new channel. The remainder of the 8' culvert will be excavated and the area reclaimed.

The remainder of the Deer Creek mine road to the Emery County road (asphalt and base) will be excavated and transported to a permitted class IV landfill.. Excavation will extend approximately 410 feet past station 0+00, to the point where the county road terminates. Approximately 30,817.16 cubic yards of material will be cut and 19,740.09 cubic yards of fill will be moved in this area. A 100 foot diameter turnaround (unpaved) will be constructed at the end of the Emery County road so that vehicular traffic can exit the area properly.

All reclaimed slopes will be pocked to enhance soil erosion control and vegetation. The reclamation plan will follow the processes outlined in R645-301-233 Topsoil Substitutes and Supplements to achieve a sufficient planting medium. Rock and other natural material will be blended with the reclaimed area to improve visual appearance and added erosion control. The area will be mulched and seeded to complete the work in this area.

Highwall Remnants

Highwall remnants are proposed at the Deer Creek Mine since sufficient fill material does not exist to completely eliminate these areas. The areas are outlined on maps DS-1782-D, 1 of 1 and DS-1783-D 1 of 2, 2 of 2. The Deer Creek Mine is considered a continuously mined area (CMA). Development of the portals began before the passage SMCRA and therefore, no spoil material was ever salvaged. Since it is impossible to completely eliminate the highwall areas, the idea is to blend these areas into the natural surroundings of the canyon to become compatible with the approved post mining land use.

The portion of the highwalls remaining consist of near vertical fluvial channel sandstone escarpments associated with the Blackhawk formation (refer to Volume 8, Geologic Section). The fill material below these areas is a combination of crushed concrete and underground development wastes. Stability of these areas are presented below. A conceptual highwall elimination plan for the Deer Creek is presented in **Appendix R645-301-500-D**. Cut and fill estimates agree with the highwall elimination plan.

Explosives Storage Area

The access road to the explosive storage area will be reclaimed using any berm and/or fill material available. All sediment control structures will be removed and the area will be pocked, mulched and reseeded.

Leach Field

The leach field servicing the Deer Creek Mine facilities will be reseeded if it is found at time of reclamation that the vegetation does not meet established guidelines. The drain rock and slotted drain pipe will be left in place.

ASCA Areas

As mentioned throughout the text, sediment control structures will be removed in all areas of the Deer Creek Mine permit area. Pocking will be the primary means of sediment control on all reclaimed surfaces. Present locations of all ASCA areas within the Deer Creek disturbance are found on Plate 1-4, Drawing CM-10882-DR in Volume 4.

C1/C2 Beltlines

The C1/C2 beltline that parallels the county road between the Huntington Power Plant coal storage facility and the mine will also be removed and reclaimed as part of the Deer Creek reclamation. After the belt structure is removed, the area will be graded using the existing berm material. The area will then be roughened and seeded to enhance moisture retention and vegetation growth. All sediment control structures (sediments traps and berms) through this area will be removed as the roughening technique will act as sediment and erosion control. A cross-sectional sketch of reclamation is shown on Drawing DS-1780-D, 4 of 5 in **Appendix R645-301-700-B**.

Slope Stability

PacifiCorp conducted a slope stability analysis on five major fills within the reclamation area. Work was performed by RB&G Engineering in April of 2000. The major fill areas include:

- Fan Area
- Mine Portal Area - Four Locations
- Waste Rock Storage Area #1
- Waste Rock Storage Area #2
- Coal Bin

The stability analyses were performed using a computer model of Spencer's Method known as UTEXAS 2. Spencer's Method satisfies both force and moment equilibrium and is considered to be a satisfactory method of solving slope stability problems.

Except in areas of limited space, backfilled slopes will be constructed not to exceed a 2H:1V gradient. All designed slopes achieved a factor of safety of >1.3. The size of material used in these fills will range between granular and bolder size of approximately 3 foot in diameter. As recommended in the slope stability report, debri placed in the coal bin will be placed in lifts and compacted to an in-place unit weight equal to at lease 90% of the maximum laboratory density as determined by ASTM D 698. The Slope Stablility Analysis report is documented in **Appendix R645-301-500-E**.

In comparison, the Rilda portals propose reclamation slopes of approximately 3:1. These slopes should be stable as designed. The 9th East portals of Meetinghouse and Grimes Wash have or will have like slopes of at least 2:1. The subsurface material at these sites are similar to the materials found at the Deer Creek Mine site. It is the permittee's opinion that these slopes will achieve a safety factor of 1.3 or above.

Reduction of Sediment Load

Deep gouging (pocking) will be the primary sediment control measure used at the Deer Creek Mine. A detailed description of this sediment control measure is outlined in R645-301-763, Siltation Structures.

Support of Post-Mining Land Use

The reclamation plan for the Deer Creek Mine is constructed to support the post-mining land use as outlined in **R645-301-400: Land Use and Air Quality**.

R645-301-553.250: Refuse Piles

A sampling program is scheduled for the field seasons of 2001 and/or 2002. A complete discussion of this program is outlined in **R645-301-200: Soils**. The chemical and physical characteristics of the material in the Deer Creek and Elk Canyon refuse sites were sampled in part of the slope stability investigations to determine if toxic and acid forming materials occur at the site. One sample point each for the Deer Creek and Elk canyon waste rock sites were taken. The sample analysis report of these sites are presented in **Appendix R645-301-200-A**. A complete discussion can be reviewed about the history of the refuse sites in Volume 2, Part 3, page 3-64. These sites are no longer in operation. The location of the sites are reviewed on Drawing DS-1796-D and in **R645-301-200: Soils**, respectively.

The waste rock site currently in operation is located along side highway 31. All information referring to this site is found in Volume 10 of the Deer Creek MRP.

R645-301-560: Performance Standards

The reclamation operations conducted at the Deer Creek Mine will be carried out in accordance to the approved permit and the requirements of R645-301-510 through R645-301-553.

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Appendix R645-301-500-A

<u>Sequence of Reclamation: Drawing DS-1781-D</u>

<u>Pre-Reclamation Surface Disturbances:</u>
Deer Creek Canyon – DS-1796-DR, 1 of 2, 2 of 2
Rilda Canyon – DS-1800-D
North Meetinghouse Canyon – DS-1798-C
Grimes Wash – DS-1799-C

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Appendix R645-301-500-B

Reclamation Plans

Rilda Canyon Facilities
9th East North Meetinghouse Portals
9th East Grimes Wash Portals

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Rilda Canyon Facilities

RECLAMATION-RILDA CANYON SURFACE FACILITIES

~~Interim Reclamation~~

~~Interim reclamation of disturbed areas will be implemented as described on pages 4-34 *through 4-36.*~~

Final Reclamation

Final reclamation of the Rilda Canyon Surface Facilities includes removal of the portal liners, portal sealing, removal of the facilities (fan, substation, pumphouse and water tank), removal of the pad and regrading of the pad area, removal of culverts, construction of reclaimed channels, regrading of the access road and reestablishing the Forest Development Trail, redistribution of topsoil and revegetation. Removal of the powerline will be accomplished through Utah Power personnel in accordance with USFS requirements.

Structure Removal

Upon completion of mining, the surface facilities structures will be dismantled and removed from the permit area and National Forest lands.

All structural steel, metal siding and other building materials associated with the fan installation, water tank and pumphouse, will be dismantled and salvaged or disposed of outside the permit area at an approved site. Concrete foundations and portal liners will be broken up and removed from the permit area for disposal at the Deer Creek Waste Rock Site.

Portal Sealing

The concrete portal liners associated with the two (2) portals will be demolished and removed from the permit area for disposal at the Deer Creek Waste Rock Site in accordance with current regulations. The portals will be sealed and backfilled as depicted in Figure 1, page 4 5-3. Backfill material will be obtained from the facility pad.

Substation and Powerline Removal

The substation will be dismantled and the structural steel and electrical components will be salvaged. The concrete foundation material will be broken up and removed from the permit area for disposal at the Deer Creek Waste Rock Site in accordance with the current regulations. The powerline will be salvaged and removed from the permit area by others in accordance with the USFS special use permit issued to Utah Power.

Pad and Access Road Removal

Approximately 11,280 cubic yards of pad material will be used for portal backfill and pad site and access road regrading. The remaining approximately 3,010 cubic yards of material will be hauled off-site by the reclamation contractor and disposed of at the Deer Creek Waste Rock Site. All materials used for backfilling and grading will be non-toxic, non-acid forming.

The pad area and access road will be regraded as shown on Drawing CE-10853-EM, Packet 4-4A, Sheets 1 through 3. Following backfilling and grading, the surface of the backfilled material will be in an uncompacted, rough condition. If areas develop where the surface is not in such condition, the material will be ripped and roughened using trackhoes, dozers and/or had tools to eliminate slippage surfaces and promote root penetration. The areas will then be covered with a 12 inch layer of topsoil. Topsoil material will be redistributed on the regraded areas using backhoes, excavators and dozers. Following redistribution, the topsoil will be sampled and analyzed for fertility and other parameters listed within the Revegetation section of the MRP. *R*eclaimed areas within the Mountain brush/Salina wildrye community will be seeded with the pinyon-juniper seed mixture listed on page ~~4-38 and 4-39~~ 3-3, R645-301-300: Biology. Reclaimed areas within the Aspen/Fir/Dogwood and the Spruce/Fir coniferous forest communities will be seeded with the following seed mixture:

RIPARIAN

Grasses		lbs/acre PLS
Streambank wheatgrass	Agropyron riparium var. Sodar	2
Indian ricegrass	Oryzopsis hymenoides var. Paloma	2
Needle and thread grass	Stipa comata	2
Slender wheatgrass	Agropyron trachycaulum	2
Western wheatgrass	Agropyron smithii	2
Kentucky bluegrass	Poa pratensis	1
Mountain Brome	Bromus carinatus	2
Blue wildrye	Elymus glaucus	1
Forbs		
Louisiana sage	Artemisia ludoviciana	2
Silky lupine	Lupinus sericeus	10
Northern sweetvetch	Hedysarum boreale	.5
Eaton penstemon	Penstemon eatonii	2
Blue aster	Aster glaucodes	.5
	Total	29
Shrubs, Container Stock		Plants/acre
Rocky Mtn. maple	Acer glabrum	400
Saskatoon serviceberry	*Amelanchier alnifolia*	400
Oregon grape	*Berberis repens*	400
Woods rose	*Rosa woodsii*	400
Booth willow	*Salix boothii*	400
Red-osier dogwood	*Cornus stolonifera*	600

Trees, Container Stock			
White fir	*Abies concolor*		100
Narrowleaf cottonwood	*Populus angustifolia*		200
Douglas fir	*Psuedotsuga menziesii*		100
		Total	3,000

Woody plant density standards for success are 900 and 3,000 woody plants per acre for mountain brush/salina wildrye and aspen/fir/dogwood (including spruce/fir coniferous forest) communities respectively. If monitoring, during the second year following reclamation, indicates the density standards are not being met, supplemental stocking of containerized plants will be initiated to achieve the required standards. Final revegetation methods, maintenance, monitoring and sampling as discussed ~~on pages 4-42 through 4-51~~ above apply to the Rilda Canyon area.

Surface Drainage Control

Removal of the undisturbed bypass culverts will occur concurrently with pad and access road removal. The CMP culverts will be removed from the permit area and salvaged. The reclamation channels will be constructed as described in the Surface Runoff Control Plan found in Volume 3, Appendix VII. Silt fence with wire mesh backing will be installed for sediment control down-grade from the reclaimed areas at locations where natural concentration of flows occurs (see Plate 4-1A). Additionally, numerous depressions will be constructed with a track-hoe bucket to create a roughened, dimpled surface in the reclaimed areas. The silt fence will be maintained until vegetation is reestablished sufficient to control sediment.

Maintenance and Monitoring

Reclamation maintenance and monitoring will be conducted as outlined ~~beginning at~~ on page ~~4-48~~ **3-7 in Section R645-301-300:Biology**.

~~Grading Along the Contour~~

~~All final grading and placement of topsoil will be done along the contour, as discussed on page 4-53, to minimize subsequent erosion and instability.~~

Riparian Enhancement, Restoration and Mitigation Measures

Riparian habitat mitigation measures will be implemented as part of the reclamation of the disturbed Aspen/Fir/Dogwood community. In cooperation with the USFS and UDWR, areas which may be benefited by shrub stocking will be identified in the vicinity of the reclaimed Rilda Canyon Facility site. Cuttings of the following woody species will be planted in the identified areas.

Woody plant		Cuttings/acre
Golden current		200
Squawbush		200
Choke cherry		200
Red-osier dogwood		200
Woods rose		200
Willow		200
	Total	1,200

Approximately 1.1 acres of Aspen/Fir/Dogwood community is affected by pad and road construction and reclamation. Therefore, 4.5 acres of adjacent riparian area will be enhanced through shrub stocking.

RILDA CANYON EARTHWORK
Mass Balance Quantities (cu. yds.)
Refer to Drawing CE-10891-EM, Sheets 1 through 3

	Stationing	Cut	Fill	Excess
Facility pad	2+30 to 2+80	698.4	0	698.4
Construction	2+80 to 5+30	0	8934.2	-8934.2
	3+50 to 5+30	3226.2	0	3226.2
Subtotal		3924.6	8934.2	-5009.6
Road	2+80 to 4+74	80.0	0	80.0
Construction	3+03 to 14+26	0	1613.2	-1613.2
	6+93 to 14+26	1262.6	0	1262.6
Subtotal		1342.6	1613.2	-270.6
Total		**5267.2**	**10547.4**	**-5280.2**

Approximately 10,547.4 cu. yds. of material are required for construction of the facility pad and road, Only 5,267.2 cu. yds. will be generated by excavation on-site, leaving a deficit of 5,280.2 cu. yds. However, approximately 3,742.9 cu. yds. of the excavated material is topsoil (see Drawing CE-10866-EM) which will not be used for pad or road construction. Therefore, a total deficit of 9,023.1 cu. yds. exists (5,280.2 + 3,742.9). This material will be purchased for pad and road construction.

	Stationing	Cut	Fill	Excess
Facility pad Reclamation	2+30 to 5+30	0	7037.2	
Road Reclamation	2+80 to 14+26	0	3946.0	
Portal Backfill	2 ea. (25'x8'x20')		296.3	
Total		**0**	**11279.5**	

Material available from pad and road fill	10547.4
Topsoil salvaged during construction	3742.9
Total material available for reclamation	14290.3
Material needed for final reclamation	11279.5
Excess fill to be hauled to waste rock site	3010.8

RILDA CANYON RECLAMATION COST SUMMARY

Item	Description	Construction Days	Cost
17A	Binwall	1.1	$ 2,999.00
17B	Parallel Fans	6.8	$ 25,623.00
17C	Pumphouse/water Tank	5.1	$ 15,408.00
17D	Substation	1.1	$ 2,779.00
17E	Portals	3.0	$ 5,778.00
17F	Culverts and Riprap	3.0	$ 9,241.00
17G		3.7	$ 18,195.00
17H	Revegetation	9.0	$ 9,095.00
17I	Monitoring and Maintenance	12.0	$ 12,000.00
17J	Supplemental Stocking	2.0	$ 1,025.00
Total		**47.0**	**$ 103,943.00**

Item	Description	Construction days	Cost
17A	Binwall	1.1	$ 2,999
17B	Pad and road	6.8	25,623
17C	Parallel fans	5.1	15,408
17D	Pumphouse/water tank	1.1	2,779
17E	Substation	3.0	7,578
17F	Portals	3.0	9,241
17G	Culverts and riprap	3.7	18,195
17H	Revegetation	9.0	9,095
17I	Monitoring and maintenance	12.0	12,000
17J	Supplemental stocking	2.0	1,025
	Total	47.0	$103,943

Labor rates and equipment costs were obtained from Means Heavy Construction Cost Data, 7th Annual Edition, 1993. Equipment specifications were obtained from Caterpillar Performance Handbook, 23rd Edition, October, 1992.

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9th East North Meetinghouse Portals

The following outlines the plan for the proposed final reclamation for the 9th East North Meetinghouse Canyon portals. Reclamation will be conducted at a time when the portals are no longer needed to ventilate the mine.

The 9th East North Meetinghouse Canyon portals were developed as intake and escapeway portals in 1986 (refer to Drawing DS1798C in Appendix R645-301-500-A). Each of the two portals consist of a single entry approximately eight (8) feet by sixteen (16) feet. The portals were developed from inside the mine and, therefore, no other surface disturbance (i.e. road construction) is associated with them. Excavated material from the portals is stored inside the mine and will be used as backfill during reclamation. No topsoil segregation was accomplished with the methods used during construction.

According to State and Federal regulations, all lands disturbed by coal mining and reclamation activities will be backfilled, graded, and revegetated according to an approved plan. The following discusses the applications that will be applied during final reclamation of the two remote portals.

R645-301-100: General

All requirements in this section have been met and can be found in the Deer Creek MRP, Volume I, pages 1-1 through 1-21.

Legal Description of the 9th East North Meetinghouse Canyon Portals

Portal #1

Location:	Beginning at the SE corner of Section 33, Township 16 South Range 7 East S.L.B.&M., thence, N 39°08'17"E, 603.36 feet. The area within a 20 ft. X 20 ft. portal breakout.
Subsurface Owner:	Bureau of Land Management: Federal Coal Lease: U-47979 (refer to Chapter 1, Volume 1)
Surface Owner:	United States Forest Service
Coal Seam:	Blind Canyon
Mine Section:	9th East
Date of Development:	October, 1986
Associated Facilities:	None

Portal #2

Location:	Beginning at the SE corner of Section 33, Township 16 South Range 7 East S.L.B.&M., thence, N 49°12'42"E, 694.38 feet. The area within a 20 ft. X 20 ft. portal breakout.
Subsurface Owner:	Bureau of Land Management: Federal Coal Lease: U-47979 (refer to Chapter 1, Volume 1)
Surface Owner:	United States Forest Service
Coal Seam:	Blind Canyon
Mine Section:	9th East
Date of Development:	October, 1986
Associated Facilities:	None

R645-301-200: Soils

The 9th East North Meetinghouse Canyon portals consist of two breakouts, each approximately sixteen (16) feet wide by eight (8) feet high, located on an extremely steep slope. Natural coal and sandstone outcrops exist throughout the area. Approximately 0.02 acres was impacted by the two breakouts. Due to the construction methods used, soil material was not salvaged or stored at the site. The coal seam is not exposed at the site except at the portal openings. During the backfilling process material which was originally excavated from the portal breakouts and stored within the mine will be used to backfill the portal entries.

During the construction process, native soil material was used to construct a berm around the disturbed area to prevent disturbed runoff from impacting the undisturbed area. This material along with native material from the adjacent areas will be utilized to establish a vegetative cover over the backfilled openings. A certified noxious weed free alfalfa mulch will be incorporated into this material to enhance the organic content of the soil. The soil cover will be placed in a roughened state to enhance moisture retention and to prevent erosion over the reclaimed areas. Rock and other aesthetically appealing materials will be strategically placed on the reclaimed site to blend the portal sites into the surrounding terrain.

R645-301-300: Biology

Following backfilling and grading, an approved final seed mixture will be placed on the reclaimed site. Revegetation techniques will be as follows:

- Remove portal collar structure and store in abandoned entries.
- After backfilling with rock material, the portal sites will be covered so that all disturbed slopes are adequately covered with soil material. Native soil will be utilized as topsoil fill material at the portal area.
- During soil placement, a certified noxious weed free alfalfa mulch will be incorporated into the soil. The soil will be roughened to control runoff and erosion.
- The seed mixture will be broadcast by hand onto the reclaimed slopes. See mixture below.
- The soil surface will be turned lightly by hand raking to cover the seeds.
- Litter material (rocks and tree branches) will be placed on the surface to protect against erosion.

Seed Mixture - Final Revegetation for the Deer Creek 9th East North Meetinghouse Canyon Portal Breakouts

Common Name	Scientific Name	Lbs/Acre PLS*
Grasses		
Western wheatgrass	Agropyron smithii	3.0
Bluebunch wheatgrass	Agropyron spicatum	3.0
Indian ricegrass	Oryzposis hymenoides	3.0
Needle and thread grass	Stipa comata	1.0
Thickspike wheatgrass	Agropyron dasystachyum	1.0
Forbs		
Blueleaf aster	Aster glaucodes	0.5
Utah sweet vetch	Hedysarum boreale	1.0
Lewis flax	Linum lewisii	1.0
Globemallow	Sphaeralcea coccinea	0.5
Yarrow	Achillea millefolius	0.5
Shrubs		
Serviceberry	Amelanchier alnifolia	1.0
Mountain big sagebrush	Artemesia tridentata vaseyana	0.5
	Total	**16.0**

The seed mixture listed above was reviewed and approved by the surface management agency (John Healy, Ferron Office, July 12, 2001). Total disturbance before reclamation is approximately 0.02

acres. This equates to approximately 0.32 lbs of pure live seed to complete revegetation at the 9th East North Meetinghouse Canyon portals.

Performance Standard: As described above, soil resources at the portal site is limited. During the enhancement project, care will be taken to prevent damage to existing vegetation. Rock litter and aesthetically appealing materials will be strategically placed on the reclaimed slopes to blend the portal sites into the surrounding terrain. Portals will be backfilled using rock material from inside the mine. Soil and native material from berms and adjacent areas will be utilized to establish a vegetative cover over the backfilled openings.

Weed control will not be undertaken unless it is determined necessary due to weed dominance and delayed rate of succession. All noxious weeds will be eradicated either chemically or physically if they become established on the site.

Rodent damage on revegetated areas will be assessed during monitoring periods. Species specific control measures will be implemented as necessary.

Annual monitoring will also include inspection for rills and gullies. Should these be present, they will be filled and the soil reseeded. Rill and gully repair will follow the regulations set forth in the Coal Rules R645-301-357.360 through R645-301-357.365. As repairs are recognized, the Division will be notified and the affected area will be reported in the annual vegetation report.

Because the reclaimed portals are such an insignificant area compared to the area as a whole, vegetation monitoring will be undertaken as outlined in the following table until the performance standards have been met. When these standards are met, Phase III Bond Release will be applied for and the Division may grant the release. Standards for success are outlined below.

10 Year Revegetation & Monitoring	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year	9th Year	10th Year
Plant Monitoring Disease * Pest Control*		✔ ✔	✔ ✔	✔ ✔	✔ ✔	✔ ✔	✔ ✔	✔ ✔	✔ ✔	✔ ✔
Soil Stabilization Rills & Gullies		✔	✔	✔	✔	✔	✔	✔	✔	✔
Contingent Seeding		✔			✔					
Revegetation Inventory for Bond Release									✔	✔

*Monitoring is conducted once per year during the spring.

Standards for success: A reference area will be located adjacent to the reclaimed portals. Cover and diversity of the reclaimed portal areas will be compared to the reference areas.

The line intercept or ocular estimation methods will be used to measure cover and species composition. As per the Division's recommendations, the shrub density standard is set at zero (0). Any shrub or woody species found on the site will be recorded by species and numbers and reported in the annual report. The standards for success to be applied for ground cover on the reclaimed areas will be at least equal to 90% (with a 90% confidence level) to that of the respective reference area at the time of bond release.

At the time of bond release, similarity between the reclaimed area and corresponding reference area will compare life forms and/or species present in each community by the use of a similarity index. Indices of similarity provide the means of mathematically comparing the plant communities in the two areas. One of the three indices, or a combination thereof, found in the Vegetation Guidelines, Appendix B will be used to determine the similarity between the reclaimed and reference area. If another index is used, or combination thereof, Division approval will be required. Similarity will be determined successful when the index value is at least 70% of the reference area.

Protection of Fish and Wildlife

Fish and wildlife information is provided in the Deer Creek MRP. Since reclamation work with machinery will be conducted from inside the mine there is not expected to be any significant impact on wildlife resources.

R645-301-400: Land Use and Air Quality

Post-mining land use for the Deer Creek Mine is grazing and wildlife. Given th fact that the portals are located on extremely steep slopes, this area is only considered for wildlife. It is highly unlikely that cattle could access the steep ledges in and around the portal areas. Recent site visits found no signs of any cattle grazing in the immediate area.

R645-301-500: Engineering

As stated earlier, the remote portals were developed for ventilation and emergency escapeways in 1986. At final reclamation the portals will be backfilled for approximately 25 feet inby the openings using rock material from inside the mine. This will be accomplished using underground mining machinery. Once the portal entries have been backfilled, a MSHA approved seal will be constructed using solid concrete blocks. The seal will be chinked into the roof, ribs, and floor of the mine. Intercepted mine water is not expected to flow from the portals, therefore, the seals will not require a hydrologic drain.

Non-Coal Waste: The portal area will be inspected for non-coal waste. All waste materials associated with the reclamation activities will be removed from the site and disposed of at an approved landfill.

The portal liners at each of the breakouts willl be removed to the extent possible and disposed of inside the mine.

Coal Waste: Recent site inspections found no coal waste at the portal areas. However, if coal waste occurs during reclamation activities, it will be cleaned up and disposed of inside the mine.

Backfilling: As mentioned, the portal entries will be backfilled using rock material from inside the mine. Approximately 120 yds^3 per portal will be need to accomplish this task. Efforts will be made to fill all voids when backfilling. The slope of the rock material at the opening of each portal will not exceed 2:1(refer to typical portal seal diagram in R645-301-500: Engineering, page 5-3). The portals have been cross-sectioned and drawn to show construction details of backfilling, sealing, and grading. Refer to Attachment #1 for typical reclamation details.

Grading: The berms protecting the off-site areas contain approximately 2.2 yds3 of soil material which will be utilized as a vegetative cover. While this is not a substantial quantity, the remaining material will be taken from the surrounding area using hand tools. Care will be taken to prevent damage to existing vegetation surrounding the portals. The portal site will be adequately covered so that all disturbed slopes can support vegetation. Litter material will be placed on the newly graded soil to control erosion. The area will be revegetated as outlined in R645-301-300: Biology.

R645-301-600: Geology

Refer to Volume 8 (Geologic Section) for a full discussion of the geology of East Mountain and the 9th East North Meetinghouse Canyon portal areas.

Subsidance: Four enteries were developed for the 9th East North Meetinghouse Canyon portal area. Only two are broke out into the canyon. No subsidence has been documented or is expected (refer to Annual Subsidence Reports).

R645-301-700: Hydrology

This section provides a detailed description of the hydrology, including groundwater and surface water of the 9th East North Meetinghouse Canyon portal area.

To provide necessary ventilation and emergency escapeways for the Deer Creek Mine, entries were developed in 1986 from the 3rd North Mains to the North Fork of the Meetinghouse Canyon. Ventilation breakouts in Meetinghouse Canyon consists of two (2) portals near the head of Meetinghouse Canyon approximately fifty (50) feet above the canyon floor. Topography in the area is extremely steep and access is limited.

Groundwater Resources

The characteristics and usefulness of a groundwater resource are dependent upon the geology of the waterbearing strata and on the geology and hydrology of the recharge area. Groundwater movement and storage characteristics are dependent on the characteristics of the substratum. To facilitate an understanding of groundwater of the East Mountain property including the Meetinghouse Canyon area refer to Volume 9 - Hydrologic Section for a complete discussion of pertinent regional hydrologic and geologic features.

Post Mine Gravity Discharge

Post mine gravity discharge will not occur at the 9th East North Meetinghouse Canyon breakouts.

Surface Water Resources

The PacifiCorp permit area, including the Meetinghouse Canyon area, is located in the headwater region of the San Rafael River Basin. The surface drainage system of the Meetinghouse Canyon area is confined exclusively to the Huntington Canyon Creek drainage system (refer to Vol. 9 - Hydrologic Section: Map HM-1). For a complete discussion of the surface water systems of the East Mountain property including the Meetinghouse Canyon refer to Volume 9 - Hydrologic Section.

The 9th East North Meetinghouse Canyon portal area consists of approximately 0.02 acres of disturbance located on a north-facing slope in the Meetinghouse Canyon drainage. Surface flow prior to the mine development in 1986 consisted of sheet flow downslope until intersecting Meetinghouse Canyon drainage system. Enhancement of the 9th East North Meetinghouse Canyon portals will return the area to pre-disturbance overland flow.

Surface Water Quality

Meetinghouse Canyon is an ephemeral drainage which flows to Huntington Canyon Creek. The portals are located approximately three (3) miles from the confluence of Meetinghouse Canyon and Huntington Canyon Creek. Water quality and quantity in Meetinghouse Canyon is monitored above the confluence with Huntington Creek at site MHC01 as specified in Appendix A of Volume 9 - Hydrologic Section (refer to map HM-1 in Volume 9 for monitoring site location). Results of the monitoring including hydrographs and water quality statistics are reported in the Annual Hydrologic Report.

Sampling and Analysis

Water quality sampling and analysis of samples collected by PacifiCorp are conducted according to the "Standard Methods for the Examination of Water and Wastewater." No groundwater discharge has occurred from either portal site.

R645-301-800: Bonding and Insurance

The Deer Creek Mine reclamation bond is $2,500,000. Costs associated with this project have been accounted for. Insurance is provided, refer to R645-301-100:General Contents, Appendix C in Volume 1.

PacifiCorp

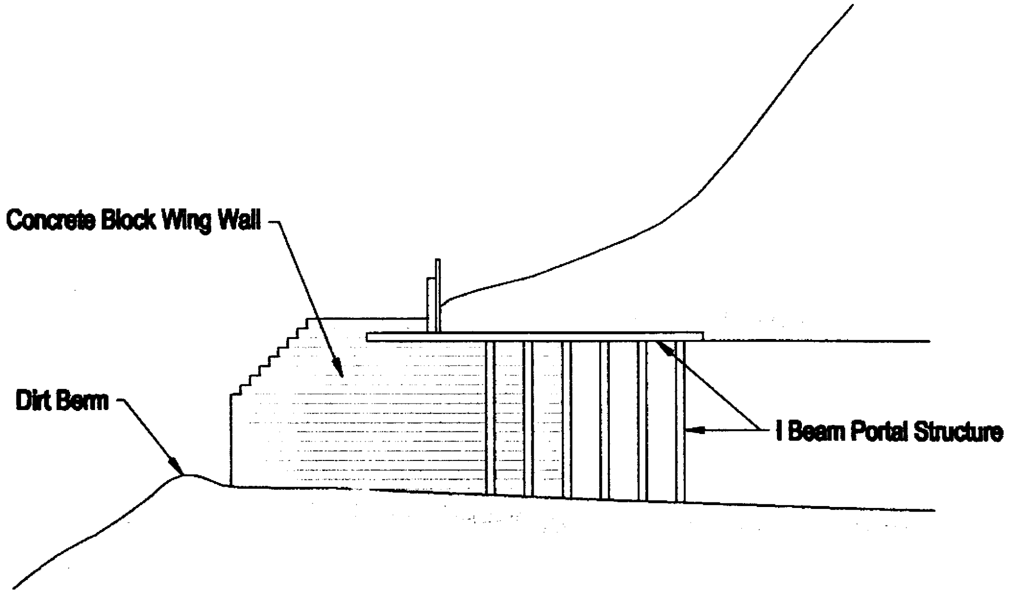
Energy West Mining Company

Deer Creek Mine

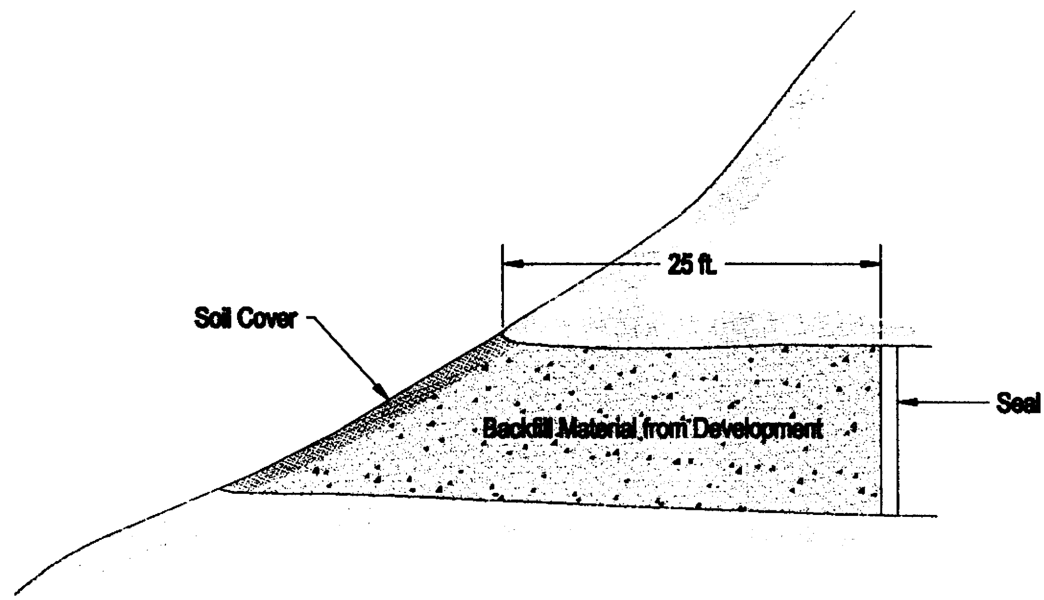
9^{th} East Meetinghouse Canyon Portal Reclamation Plan

Attachment #1

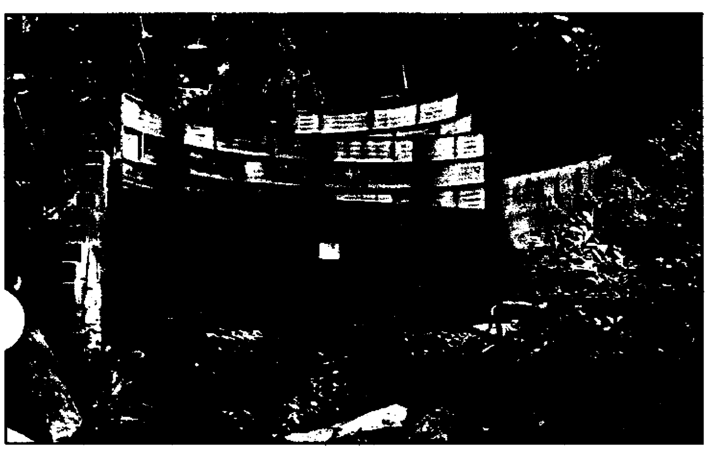
Typical Cross-sectional Portal View



Typical Portal Cross Section



Reclaimed Portal Cross Section



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ENERGY WEST
MINING COMPANY
HUNTINGTON, UTAH 84528

DEER CREEK MINE
MEETINGHOUSE CANYON BREAKOUTS
TYPICAL PORTAL RECLAMATION

DRAWN BY: *K. LARSEN*	DS1815A		
SCALE: *NONE*	DRAWING #:		
DATE: *JULY 17, 2001*	SHEET 1 OF 1	REV. ___	

PACIFICORP

ENERGY WEST MINING

Deer Creek Mine
C/015/018
Mining and Reclamation Plan

9^{th} East Grimes Wash Portals

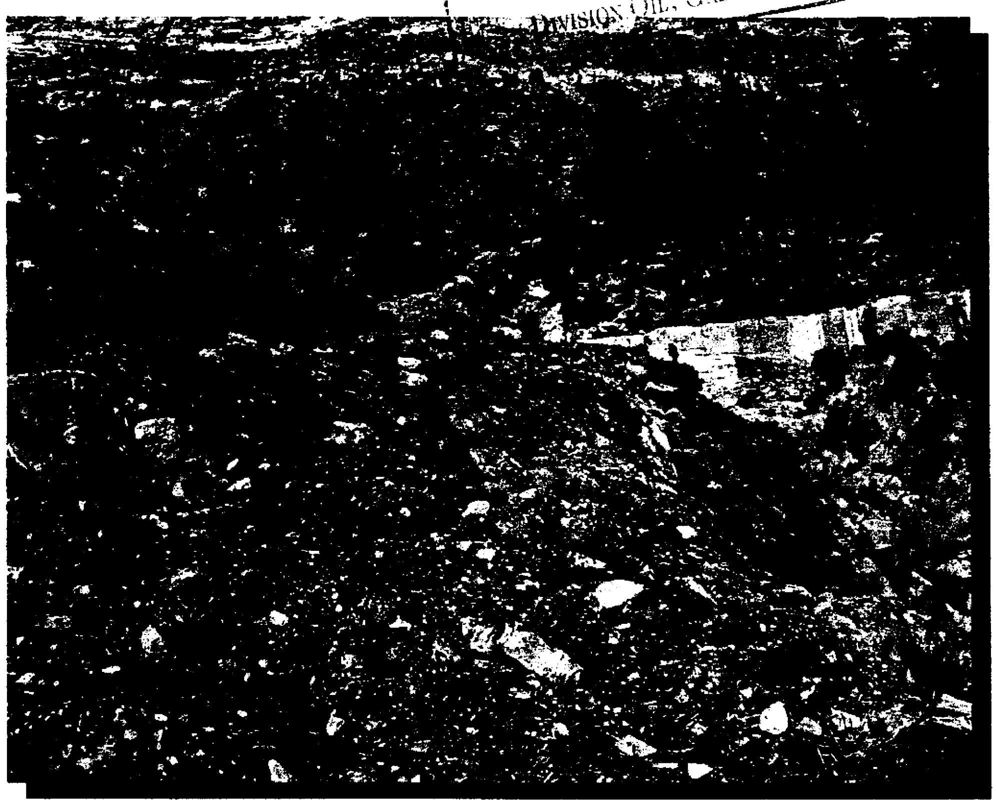
PacifiCorp
Deer Creek Mine
C/015/018

9th East Breakouts Reclamation Plan

***Pre-Reclamation Photo
View Looking North
Along Access Road***

FEB 2001 OIA

DIVISION OIL, GAS



***Post Reclamtaion Photo
View Looking North
Along Access Road***

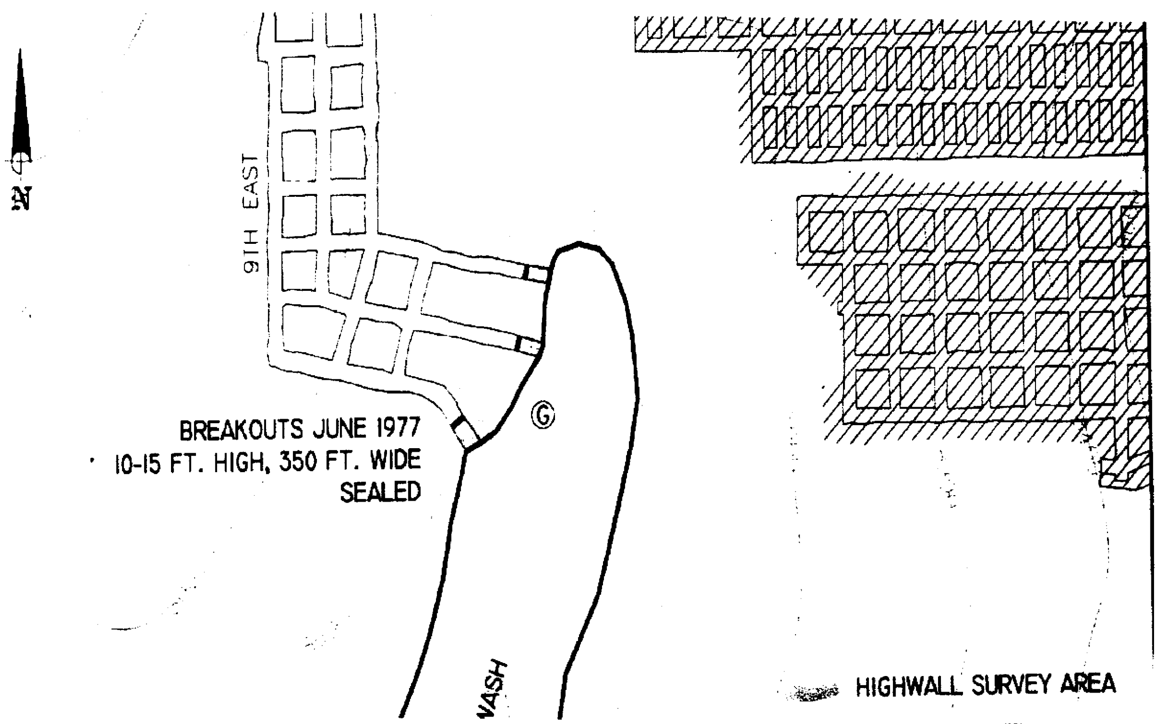
PACIFICORP

DEER CREEK MINE
9^{TH} EAST BREAKOUTS
RECLAMATION PLAN
C/015/018

INTRODUCTION

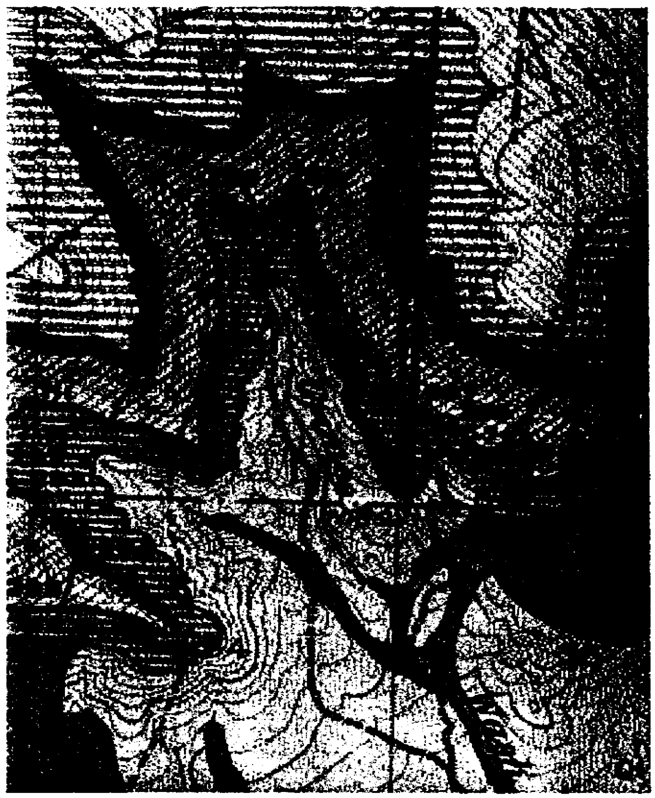
The 9^{th} East breakouts are located in the Right Fork of Grimes Wash and were developed June 1977 for ventilation purposes and are considered a pre-SMRCA site. The site consisted of three (3) separate intake portals with concrete collars.

Deer Creek Mine
9^{th} East Breakouts



Breakouts at 9^{th} East were utilized for intake ventilation purposes from 1977 until 1990 when they were permanently sealed according to Mine Safety Health Administration regulations. Final reclamation was completed in December 1999. Access to the 9^{th} East Breakouts is accomplished along an access road from the Wilberg Mine portals in the Right Fork of Grimes Wash. The access road served as drainage control for the area below the 9th East breakouts (refer to R645-301-700 for hydrologic information pertaining to the 9th East area.).

The portal site was originally disturbed by coal mining activities dating back prior to 1920's as documented by Speiker[1]. Below is an excerpt from Speiker which documents the history of coal mining in the upper Grimes Wash area:



> ***Mines in upper Grimes Wash***, - *in each of the forks of Grimes Wash is an abandoned mine (locations 288 [9th East Breakouts] and 289). The one at location 289 is the Reed mine, referred to by Taff[2]. Both are very old mines.*
>
> *The mine at location 288 is largely caved, but the coal appears unaffected by weather, and a sample was taken for analysis. Little coal has been taken from the mine and the entry is only about 75 feet long. A few short rooms have been turned off.*

[1] Speiker, E.M., 1931, The Wasatch Plateau Coal Field, Utah: U.S. Geological Survey Bulletin 819, p.160.

[2] Taff, J.A., 1906, The Book Cliffs coal field: U.S. Geological Survey Bulletin 285, p. 300.

The mine at location 289 is more extensive, but it could not be explored in 1922 because of water. It is a true wagon mine; the road leads directly to the mine mouth and wagons were driven into the mine, loaded at the face, and driven out again through a second entry near the first. An older entry south of these two, now caved shut, probably served to ventilate the mine.

At the both of these mines the coal is about 13 feet thick and is of that hard, massive type characteristics of the field. The road to the mines was in bad condition in 1922, but it is of even gradient, and when well kept it affords a good route for heavy wagons."

Remnants from the old mine include two partially open portals, coal handling area south of the portals and evidence of a wooden coal chute above the current Wilberg Mine Fan.

The following plan will address final reclamation of the 9th East breakouts including the access road from the Wilberg Mine fan. Even though the 9th East breakouts are part of the Deer Creek Mine, because of its location, environmental resources are documented in the Cottonwood Mine MRP. The plan will use the following format to described the reclamation project:

R645-301-100	***General***
R645-301-200	***Soils***
R645-301-300	***Biology***
R645-301-400	***Land Use***
R645-301-500	***Engineering***
R645-301-600	***Geology***
R645-301-700	***Hydrology***
R645-301-800	***Bonding***

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DEER CREEK MINE
9TH EAST BREAKOUTS
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100 GENERAL CONTENTS (R645-301-100)

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200 SOILS (R645-301-200)

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210. INTRODUCTION (R645-301-210)

As documented in the Introduction Section, 9th East breakouts are considered as a pre-SMRCA site. Disturbance originally occurred prior to 1922 and again in June 1977 for ventilation breakouts for the Deer Creek Mine. Soil classification/salvaging were not deployed during construction activities for either phase.

220. ENVIRONMENTAL DESCRIPTION (R645-301-220)

This section is comprised of information from Volume 2 Part 2 of the Cottonwood Mine permit. Included in this section is information from a soil survey prepared by Dr. A.R. Southard, soil scientist, Utah State University.

The 9th East breakouts are located on a east facing steep slope in the Right Fork of Grimes Wash. The area is dominated by rock outcrop, rubble land, and shallow soils. As stated in the Cottonwood MRP (Volume 2 Part 2) "Nowhere in the vicinity is there a source of material which would usually be referred to as "topsoil". Soil test on the disturbed and undisturbed areas and coal waste show that the materials in the portal areas should support selected vegetative materials. Southard reported three major conclusions:

1. Basically, no topsoil (Horizon A) exists in sufficient quantities to warrant stockpiling (based on undisturbed adjacent areas).
2. Existing materials, selectively, are acceptable as a plant growth medium.
3. Final reclamation would be enhanced, especially sedimentation control, by induced grass species.

Dr. Southard classified the soils in the vicinity of the 9th East breakouts as

$$\frac{I-E-R}{E}$$

Typic Ustochrepts-Lithic Ustorthents-Rock Oucrop Loamy-Skeletal, Shallow 40-60% Slopes

These soils are mostly loamly-skeletal and lithic with areas of sandstone outcrops. In this map unit, Typic Ustochrepts make up about 50%, Lithic Ustorthents about 25%, and rock

Outcrop Rubble Land about 20%; included are small areas of Mollisols on north and east facing slopes.

The Ustochrepts can be generally described as follows: pale brown gravelly loam or sandy loam surface layer, with 25% sandstone fragments, 35 cm thick, underlain by a pale brown gravelly or stony loam, with 35-50% sandstone fragments, 100 cm thick.

The Ustorthents are mostly shallow, underlain by rock within 50 cm of the surface.

Rubble Lands are those areas where the soils are covered by large boulders so close together that there is little area between the boulders for plants to grow.

Rock Outcrop is exposed areas of bedrock. These areas are often nearly vertical cliff walls in canyons.

Taxonomic classification (reclassified by Dr. A. R. Southard, May 1989) is loamy-skeletal mixed mesic Lithic Ustorthents. Pedon description follows:

A

0-4 inches; pale brown (10YR 6/3) very gravelly loam; olive brown (2.5Y 5/4) when moist; weak, fine granular structure; friable, slightly plastic; few fine, medium, and coarse roots; common fine and few medium pores; 55% gravel; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.3); abrupt wavy boundary.

C

4-14 inches; light gray (2.5Y 7/2) extremely flaggy, fine sandy loam, light yellowish brown (2.5Y 6/4) when moist; massive; very friable; few fine, medium, and coarse roots; 40% flagstones; 30% channeres; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); abrupt smooth boundary.

R

14 inches; sandstone.

The soil samples contained in the Cottonwood Mine MRP, Volume 2 Part 4 were carried out in conjunction with the Order I soil survey used to classify the soil types of the surrounding Cottonwood Mine area. Soil samples were taken at numerous locations to determine the suitability of the soil for potential reclamation. The soil sampling referenced in Part 2 of the Cottonwood MRP were carried out in 1980, 1983 and 1989 (refer to Cottonwood MRP, Volume 2, Part 4, "Soils Of The Wilberg Mine Site: Report On Physical And Chemical Analysis"). A series of samples (denoted on Map 2-18 as 1112-1116) were collected on a pre-SMCRA fill slope near the proposed reclamation site. The following table lists the physical and chemical properties of the samples collected in 1980:

Wilberg/Cottonwood Mine Soil Samples							
Physical Analysis							
Sample #	**Identification**	**Sand**	**Silt**	**Clay**	**Texture**	**pH**	**ECe**
1112	0-6"	63	24	13	SL	8.2	0.6
1113	6-14"	63	26	11	SL	8.4	0.4
1114	14-21"	60	27	13	SL	8.0	1.2
1115	21-31"	57	28	15	SL	8.5	0.7
1116	31-45"	58	28	14	SL	8.4	1.5
Chemical Analysis							
Sample #	**SAR**	**%OM**	**(Ca+Mg)**	**Na**	**%K**	**P(ppm)**	
1112	0.3	4.4	5.2	0.5	0.02	2.9	
1113	0.3	2.1	4.1	0.5	0.02	2.1	
1114	0.4	1.3	9.7	0.9	0.02	0.6	
1115	0.5	1.5	5.7	0.8	0.02	0.3	
1116	0.4	1.3	14.5	1.2	0.02	0.1	

Physical Analysis: All of the samples have sandy loam textures, with no apparent variation with depth.

Chemical Analysis: Soil reaction (pH) ranged from 8.0 to 8.5 with no apparent trends with increased depth. Sodium Adsorption Ratios were fairly low ranging from 0.3 to 0.5.

230. SOIL OPERATION PLAN (R645-301-230)

As stated earlier, the 9th East breakouts are a pre-SMRCA site and topsoil/subsoil material was not segregated during construction activities. The site was originally disturbed prior to 1922 as documented by Speiker, U.S.G.S. Bulletin 819 (refer to Introduction Section). A baseline survey was conducted to determine the quantities of available spoil material to be used as backfill (refer to Map DS1785D). Based upon the survey, adequate fill existed to create overland flow at the portal site and along the access road. Reclamation techniques and specific quantities will be discussed in the Engineering Section.

Drawing DS1785D delineates the total disturbed area of the 9th East breakout area and access road. A Mass Diagram Table is provided on drawing DS1785D. A total of approximately 0.6 acres was reclaimed involving the portal terrace area and the access road.

240. RECLAMATION PLAN (R645-301-240)

Material from the berms located in front of the portal sites and along the access road was used as backfill as depicted on Drawing DS1785D. Material was backfilled to approximately 2:1 slope as depicted on Drawing DS1788D. Quantities for spoil distribution on the portal sites and access road are provided on Drawings DS1785D (Proposed Reclamation) and DS1788D (Final Reclamation). Salvaged material was used in the reclamation of the portal terrace and the access road from the portals to the Wilberg Mine Fan. Approximately 1,375 cubic yards of spoil was used in the reclamation of the portal terrace and access road (refer to Drawing DS1788D Final Reclamation Map).

Spoil material from the berms was removed by excavator and distributed and placed at the designated locations as indicated in Drawing DS1785D. (All material locations were staked to show crest and toe of slope). Material was compacted with the bucket of the excavator.

Soil stabilization: Compaction efforts were applied as lifts of material were placed. Large boulders were removed to allow proper compaction. Various sized rocks and boulders were randomly positioned along the portal terrace and along the access road to enhance vegetation establishment, create micro habitats, provide slope containment and to help provide natural esthetic appearance.

Erosion control: Deep gouging has been used to control sediment at the 9th East breakouts. These techniques require a track-hoe or similar machine to roughen the disturbed area in a random and discontinuous fashion using the bucket. Pockmarks created are approximately three (3) feet in diameter and one and half (1 ½) feet deep. The pockmarks are designed to capture or trap precipitation, influencing infiltration. Gouging serves to control erosion through water retention, thus enhancing vegetation growth. Because of the water retaining capabilities of deep gouging techniques, contribution of sediment above background levels are not expected. All exposed surfaces were protected and stabilized as discussed in R645-301-300.

Fertilizers and seed mix: Refer to Biology Section R645-301-300.

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DEER CREEK MINE
9TH EAST BREAKOUTS
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300 BIOLOGY (R645-301-300)

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LIST OF APPENDICES

310. INTRODUCTION

This section contains information provided from the Cottonwood MRP.

The revegetation section has a seed mix that eliminates all introduced species and utilizes other species proven in field growth as determined from monitoring. Drawing DS-1785D, depicts the past disturbance topography, allowing improved details to determine quantities and areas.

The fish and wildlife resource information provides an updated map of raptor nesting locations, status sheet of nest locations (refer to R645-301-300 Appendix A), and a reference letter of endangered species (refer to R645-301-300 Appendix B).

320. ENVIRONMENTAL DESCRIPTION (R645-301-320)

This section contains information from Volume 1 and Volume 2 of the Cottonwood MRP, updated information on endangered and threatened species, and the 1999 raptor survey results.

Results of the 1999 raptor survey near the 9th East breakouts/Cottonwood Mine Area are included in R645-301-300 Appendix A. A status sheet for raptor nests has also been included (refer to R645-301-300 Appendix A). As shown on Figure 1 (refer to R645-301-300 Appendix A), two (2) Golden Eagle nest sites (63 IA and 752 A-2C) were identified during the 1999 survey within the Grimes Wash area. Reclamation activities at the 9th East breakouts was conducted during December 1999 and did not interfere with the raptor breeding season. A letter from the Fish and Wildlife Service has been included that lists endangered and threatened species that may occur in this area (refer to R645-301-300 Appendix B).

A reference copy of the wildlife resources information on pages 2-159 thru 2-174 from Volume 2 of the Cottonwood MRP has been included (refer to R645-301-300 Appendix C). These pages contain information on wildlife habitat and vegetation for the Cottonwood Mine Site Area.

The Vegetation Information for the Cottonwood/Wilberg Mine Area report by Jerry R. Baker dated July 1982 has been included in this section (refer to R645-301-300 Appendix D). This report contains detailed information of vegetation in the disturbed area.

330. OPERATION PLAN (R645-301-330)

The 9th East breakout terrace area includes 0.40 acres of disturbed habitat. The access road from the Wilberg Mine fan to the portal terrace contains an additional 0.2 acres. The total area reclaimed in 1999 was approximately 0.6 acres.

340. RECLAMATION PLAN (R645-301-340)

Reclamation techniques of the 9th East breakout area is detailed in R645-301-500. Seeding and planting measures are included in this section under Performance Standards.

350. PERFORMANCE STANDARDS

Seed mixture for the 9th East breakout was based upon the mixture utilized for the Cottonwood Fan Portal reclaimed in 1998. The seed mix as suggested by the Division has been included (refer to R645-301-300 Appendix E). In this seed mix, all introduced species were eliminated. The mixture was also supplemented with other species proven in field growth monitoring at the Trail Mountain test plots. Revegetation techniques including issues such as slope, erosion control, and seed protection are outlined in R645-301-353.120.

Disturbed areas associated with the 9th East breakouts (portal terrace 0.40 acres, access road 0.20 acres) total about 0.60 acres. Elevation is approximately 7,800 feet with a east and southeast exposure. Slope of the project area varies from 35-40°. The native plant community is dominated by Utah juniper and pinyon pine. Common grasses are Salina Wildrye, Western Wheatgrass and Indian Ricegrass. Soils are moderately alkaline and saline (results of soil analyses are given in the R645-301-200). Surface soil texture is a silt loam. As discussed previously, this site is a pre-SMCRA site that was originally disturbed prior to 1922 and again in 1977 and soil salvaging was not implemented in either phase.

During the final revegetation, the slopes were deep gouged in a random and discontinuous fashion. Pockmarks created are approximately three (3) feet in diameter and one and half (1 ½) feet deep. The pockmarks are designed to capture or trap precipitation, influencing infiltration. Gouging serves to control erosion through water retention, thus enhancing vegetation growth.

<u>Seeding Techniques</u>

Seeding took place as contemporaneously as practical following soil placement, contouring/pocking and fertilization of the area being reclaimed. Certified weed free alfalfa hay was incorporated into the soil following contouring at a rate of 2000lbs/acre. Fertilizer was applied at the following rate:

Ammonium Nitrate 40 lbs./acre

Triple Superphosphate 35 lbs./acre

Pocking techniques mixed the alfalfa mulch and fertilizer into the upper portion of the soil. The seed mixture was broadcast using a "hurricane spreader". After seeding the area was hand raked to cover the seeds.

Next, a wood fiber mulch was applied at a rate of 1000 lbs./acre. A tackifier (Eco Aegis/Fiber Mulch) was added to the mulch and applied at a rate of 500 lbs/acre. Mulch and tackifier was applied simultaneously.

REVEGETATION (R645-301-353.120)

Seed Mixture: The following table list the seed mixture that has been established for the disturbed Pinyon/Juniper habitat. Pinyon/Juniper habitats are those areas that have a high exposure to sunlight. These areas are typically drier and need grass growth early on for moisture retention and soil stabilization.

Common Name	Scientific Name	Lbs./Acre Equivalent PLS*
Grasses		
Bluebunch Wheatgrass	Agropyron spicatum	3.0
Big Bluegrass	Poa ampla	0.5
Great Basin Wild Rye	Leymus cinereus	2.0
Indian Ricegrass	Oryzopsis hymenoides var. Paloma	3.0
Thickspike Wheatgrass	Agropyron dasystachyum var. Critana	2.0
Western Wheatgrass	Agropyron smithii var. Rosanna	3.0
Forbes		
Blueleaf Aster	Aster glaucodes	0.5
Blue Flax	Linum lewisii	1.0
Louisiana Sage	Artemisia ludoviciana	0.2
Northern Sweetvetch	Hedysarum boreale	1.0
Palmer Penstemon	Penstemon palmeri	0.5
Shrubs		
Big Sagbrush	Artemisia tridentata var. wyomingensis	0.5
Curleaf Mahogany	Cercodarus ledifolius	2.0
Fourwing Saltbush	Atriplex canescens	3.0
Saskatoon Serviceberry	Amelanchier alnifolia	1.0
Whitestem Rubber Rabbitbrush	Chrysothamnus nauseosus	0.2

Final reclamation Acres: Drawing DS1788D shows seeded locations for final reclamation. Areas depicted total 0.60 acres. Revegetation procedures of the 9th East breakout terrace and access road were outlined previously.

Maintenance, monitoring: Signs were placed around the planted slopes for there protection. The area will be entered only to provide maintenance (as needed) and/or monitoring deputies.

Weed control will not be undertaken unless it is determined necessary due to weed dominance and delayed rate of succession. All noxious weeds will be eradicated either chemically or physically if they become established on the site.

Rodent damage on revegetated areas will be assessed during monitoring periods. Species specific control measures will be implemented as necessary.

Annual monitoring will include inspection for rills and gullies. Should these be present and affect reclamation success , they will be filled and the soil reseeded. For repaired areas larger than 15% of the total reclaimed area, the Division will be notified and the affected area will be reported in the annual vegetation report.

The following table establishes a monitoring program that extends through the responsibility period of the bond:

Deer Creek Mine: 9th East Breakout Terrace and Access Road Reclamation Schedule

10 Year Revegetation & Monitoring	1st Year 2000	2nd Year 2001	3rd Year 2002	4th Year 2003	5th Year 2004	6th Year 2005	7th Year 2006	8th Year 2007	9th Year 2008	10th Year 2009
Plant Monitoring Disease & Pest Control*		✔ ✔	✔ ✔	✔ ✔	✔ ✔	✔ ✔	✔ ✔	✔ ✔	✔ ✔	✔ ✔
Soil Stabilization RIlls & Gullies		✔	✔	✔	✔	✔	✔	✔	✔	✔
Contingent Seeding		✔			✔					
Revegetation Inventory for Bond Release				✔				✔	✔	✔

*Monitoring is conducted twice per year during the spring and fall.

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ENERGY WEST MINING

Deer Creek Mine
C/015/018

Mining and Reclamation Plan

Appendix R645-301-500-C

<u>Disturbed Area Final Reclamation Contour Map: Drawing DS-1782-D</u>

<u>Final Reclamation Cross-Sections, Deer Creek Canyon:</u>
<u>Drawing DS-1783-D, 1 of 2, 2 of 2</u>

<u>Final Reclamation Cross-Sections,Elk Canyon, Deer Canyon, and Coal Bin:</u>
<u>Drawing DS-1784-D</u>

<u>Disturbed Area, Substitute Topsoil Coverage Areas: DS-1816-D</u>

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ENERGY WEST MINING

Deer Creek Mine
C/015/018
Mining and Reclamation Plan

Appendix R645-301-500-D

Highwall Elimination Plan

Highwall Reclamation:

Final reclamation of highwalls at the Deer Creek Mine is accomplished in three phases. These phases follow strict requirements set forth by the Utah Coal Rules R645-301-100 through 800. Highwalls at the Deer Creek Mine were inventoried by the Division of Oil, Gas and Mining in 1997. Seven areas of concern were found and are discussed below. Four of the areas are highwalls constructed prior to the ruling (May 3,1978) of the Surface Mining Control and Reclamation Act (SMCRA). One highwall was constructed after that date. Sites constructed prior to May 3, 1978 need only to eliminate highwalls to the extent practical using all reasonably available spoil. All post SMCRA sites are required to completely eliminate highwalls.

During Phase I of final reclamation, backfilling and grading operations will be conducted. Drainage control and replacement of topsoil will be accomplished during this phase. During Phase II, the areas backfilled and graded during previous phase will be reseeded with an approved seed mix as outlined in **R645-301-300: Biology**, page 3-2 through 3-5. Phase III, relates with all essential monitoring requirements as required by the Utah Coal Rules.

The backfilling and grading section below pertains to Phase I of final reclamation and describes each of the areas of concern evaluated by the oversite team who's goals are to eliminate highwalls by restoring them to their approximate original contour. For a visual rendition of Phase 1 final reclamation, refer to the photo essay at the end of this section. Also refer to backfilling/grading cross-sections and final contour Drawings DS-1782-D through DS-1784-D in **Appendix R645-301-500-C**.

Backfilling and Grading (Pre-SMCRA):

<u>Intake Portals</u>

Once the portals have been sealed and backfilled by the approved portal sealing plan on page 5-3 in this chapter, the concrete retaining wall and portal casings will be broken up and used as fill. Shotcrete will be removed from the cut-slope above the portal area as much as possible to return the area to its natural state. Existing spoil material will be utilized to backfill the area of the three intake portals. Because these portals are pre-SMCRA, highwall elimination to the extent practical using all reasonably available spoil is necessary. The highwall will be backfilled to an approximate slope of 2:1 as diagramed in the typical cross-section of Figure 1.

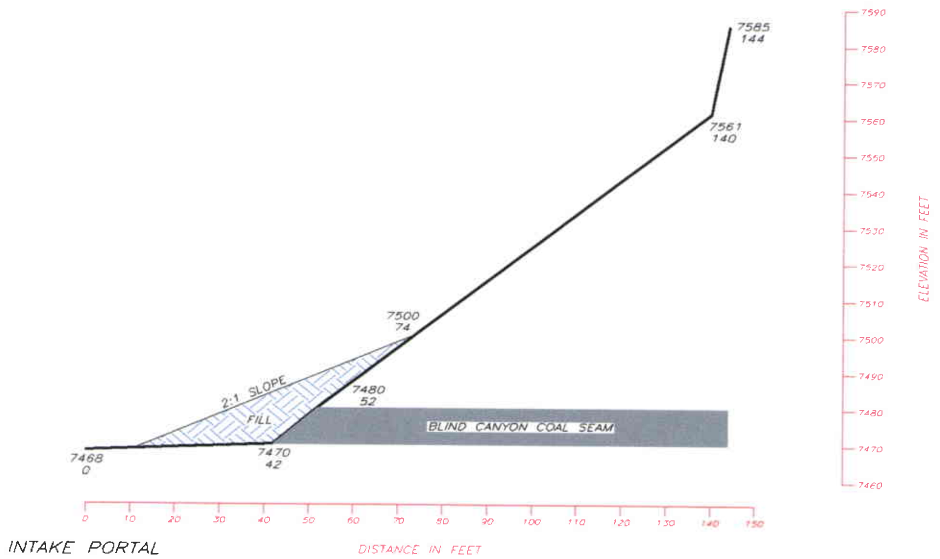


Figure 1: Typical cross-section of the Intake Portal highwall area.

<u>Belt portal:</u>

Once the belt portal has been sealed by the approved portal sealing plan on 5-3 in this chapter, the concrete casing will be broken up and used as fill. The portal will then be backfilled and graded. Existing fill will be used to backfill the area to an approximate slope of 2:1 as diagramed in the typical cross-section of Figure 2.

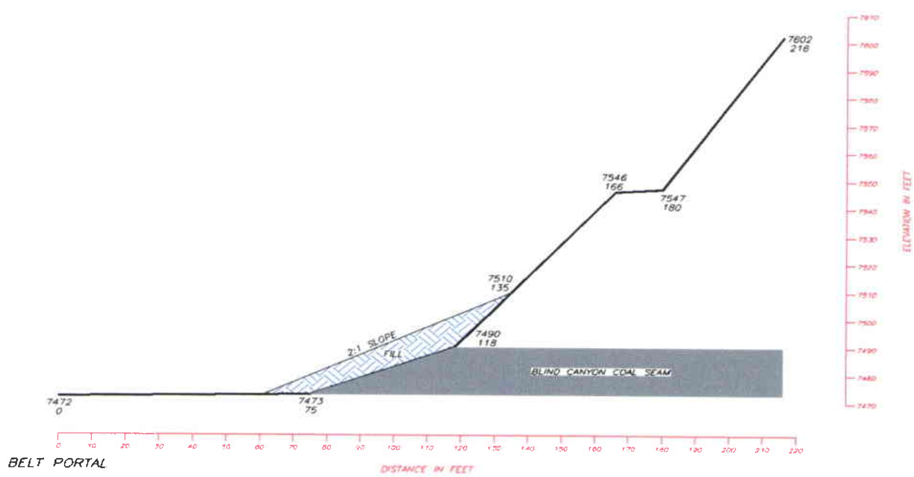


Figure 2: Typical cross-section of the Belt Portal highwall area.

Fan Portal Pad:

Once the fan assembly has been removed, the ventilation shaft will be sealed from inside the mine. Any concrete structures remaining will be broken up and used as fill for the shaft. The remainder of the shaft will be backfilled using spoil material Deer Creek Mine site. The remaining fill material will be used to backfill to an approximate slope of 2:1. The berm area will be cut and placed on the fill area to blend in with the existing slope. A typical cross-section of the fan pad reclamation is diagramed in Figure 3.

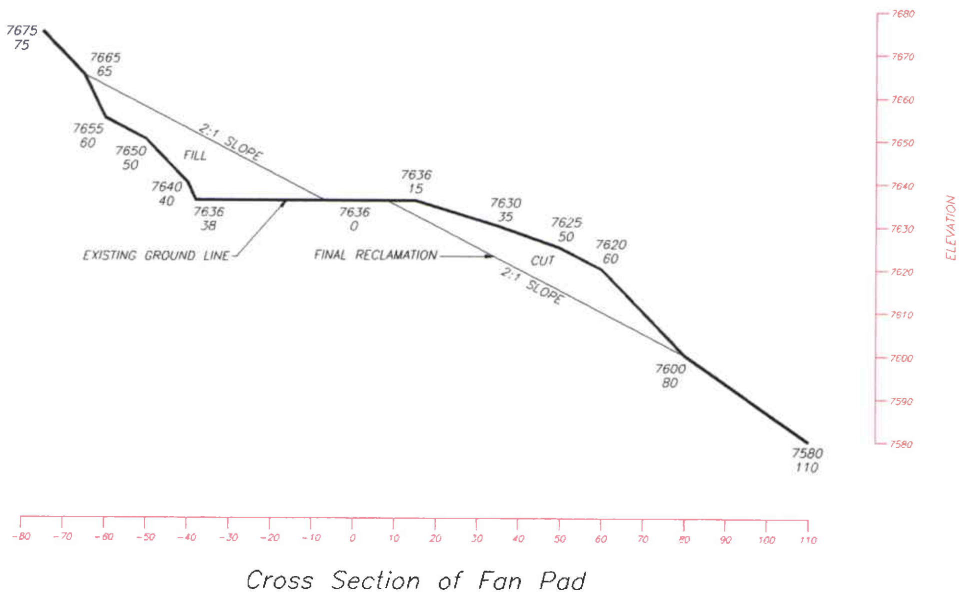


Figure 3: Typical cross-section of the Fan Portal pad.

Old McKinnon Fan Portals

Upon removal of the structures at the Old McKinnon Fan Portal site, the portal will be sealed from outside the mine following the approved portal sealing plan found on page 5-3 in this chapter. The area will be backfilled and graded using existing fill material on the pad to an approximate slope of 2:1 as diagramed in the typical cross-section of Figure 4. The berm area below the existing ROM beltline will be cut and used as fill to blend the pad and roadway area with the existing slope of the highwall area.

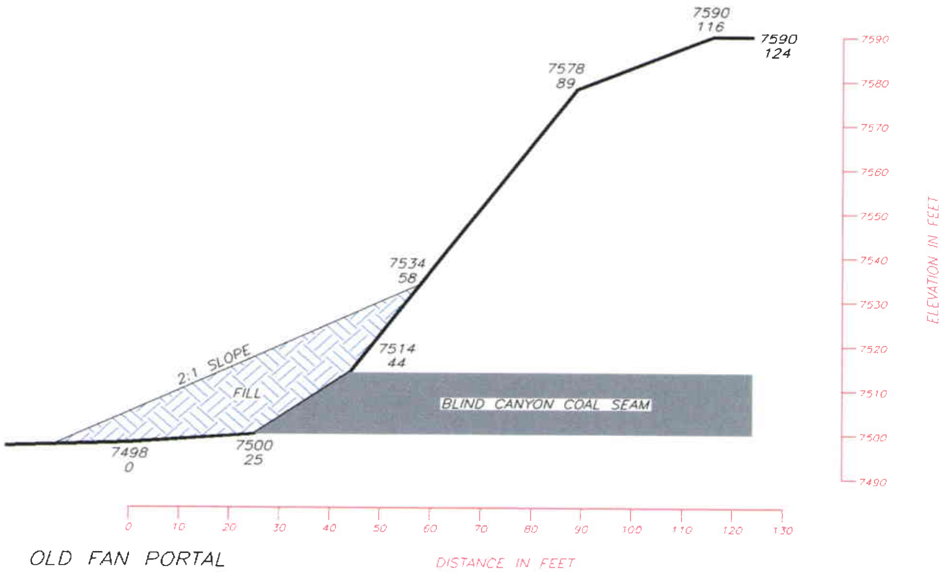


Figure 4: Typical cross-section of the Old McKinnon Fan Portal.

<u>9th East Portals above Wilberg Mine</u>

The 9th east portals were reclaimed in the fall of 1999. Refer to the discussion of the reclamation activities as provided in **Appendix R645-301-500-B.**

<u>9th East Portals in Meetinghouse Canyon</u>

There are no highwalls associated with the two intake portals. The portals will be sealed from inside the mine according to the approved sealing plan on page 5-3 of this chapter.

Backfilling and Grading (Post-SMCRA)

<u>Rilda Canyon Breakouts</u>

See Reclamation Plan in **Appendix R645-301-500-B.**

Photo Essay

Highwall Elimination at the Deer Creek Mine

ACT/015/018

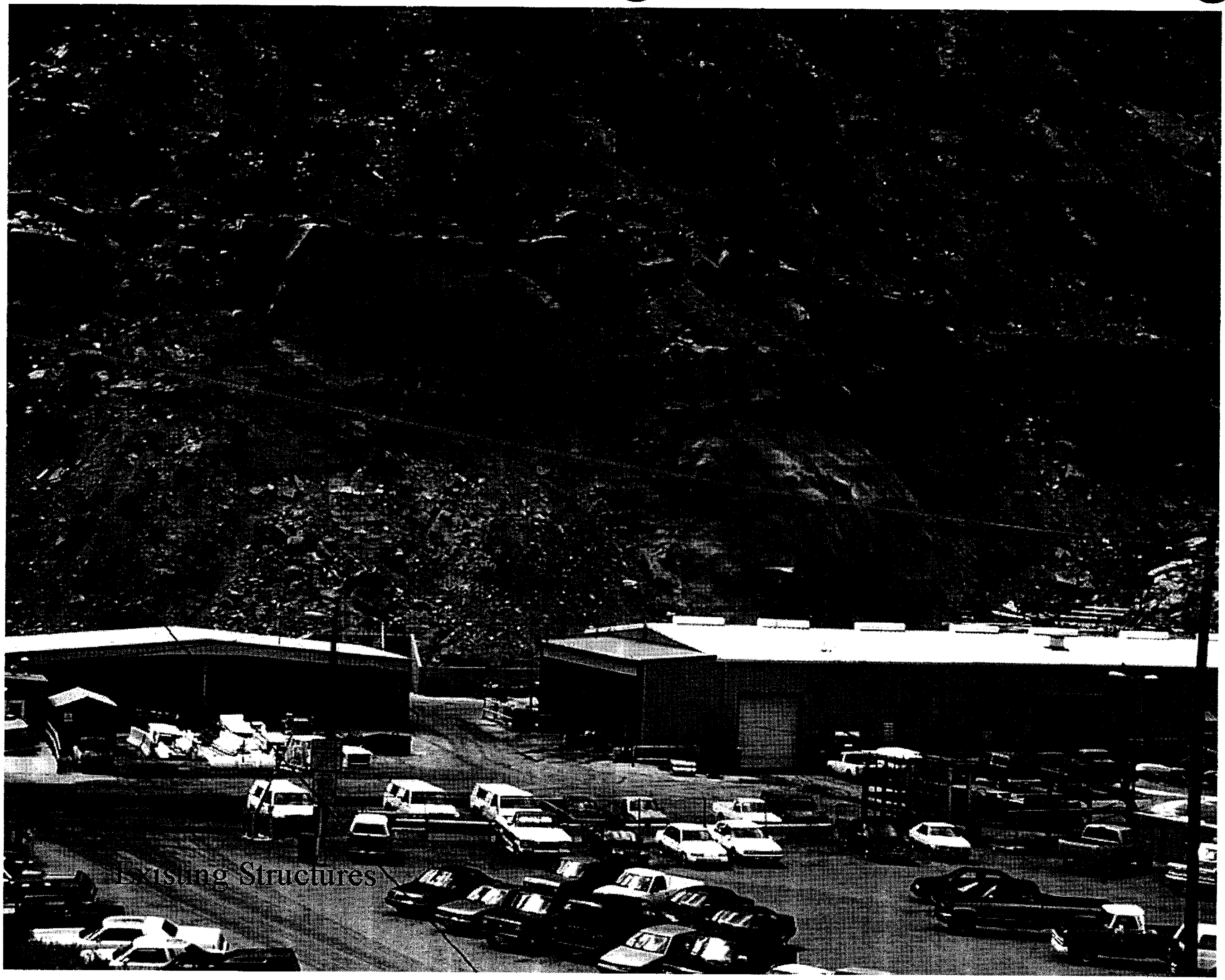
Contents:

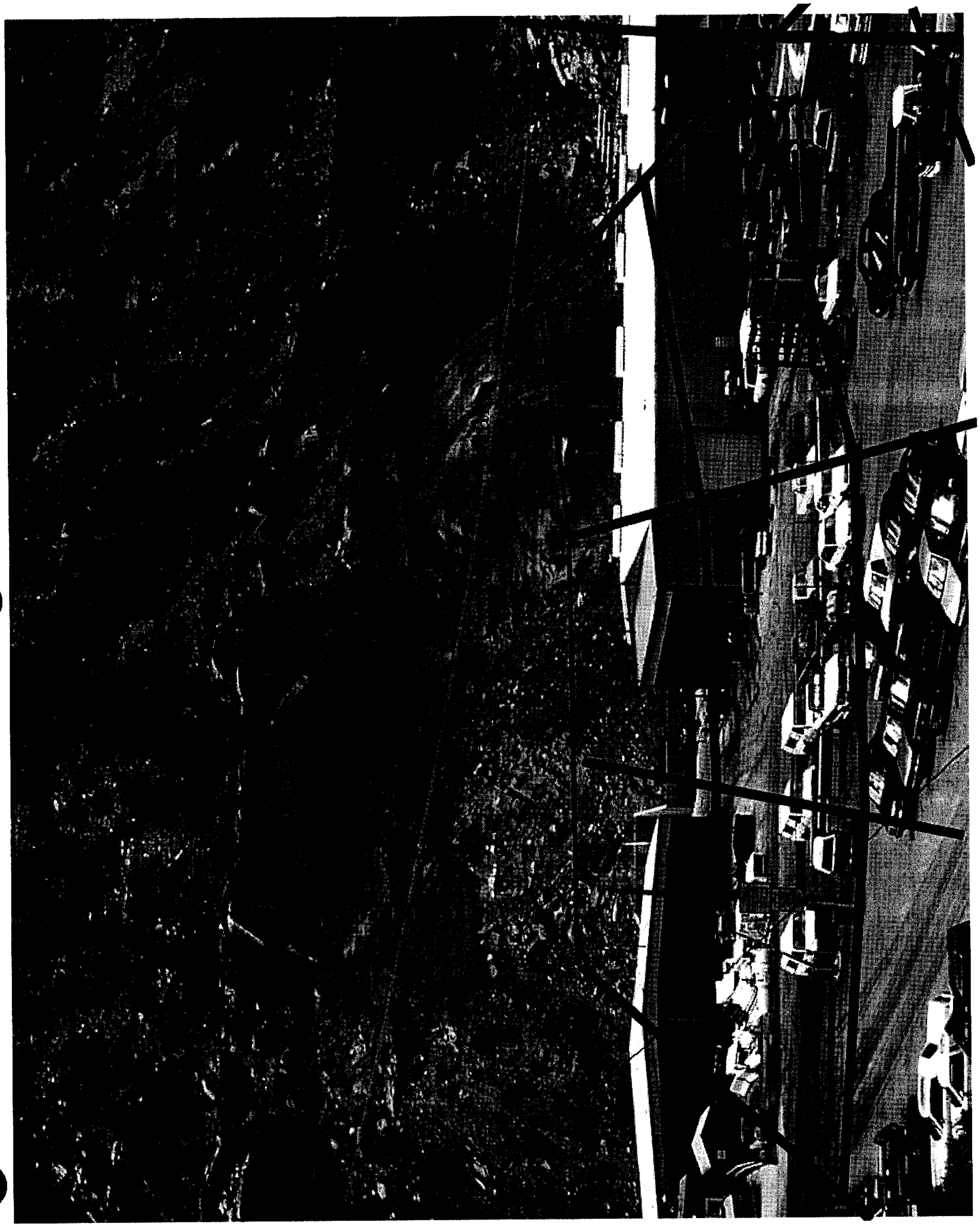
- Intake Portal Area
- Belt Portal Area
- Fan Portal Area
- Old McKinnon Fan Portal Area

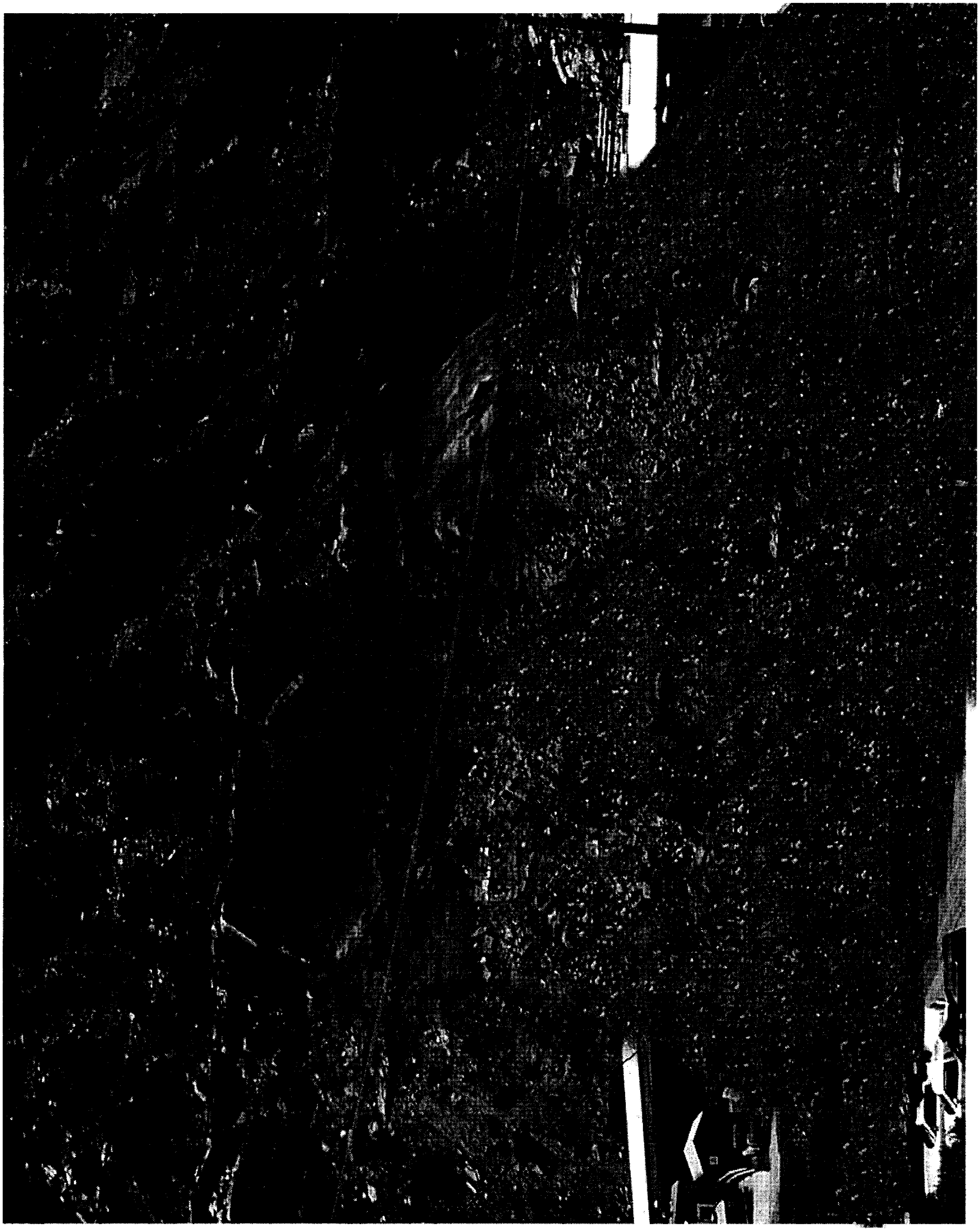
Intake Portal Area

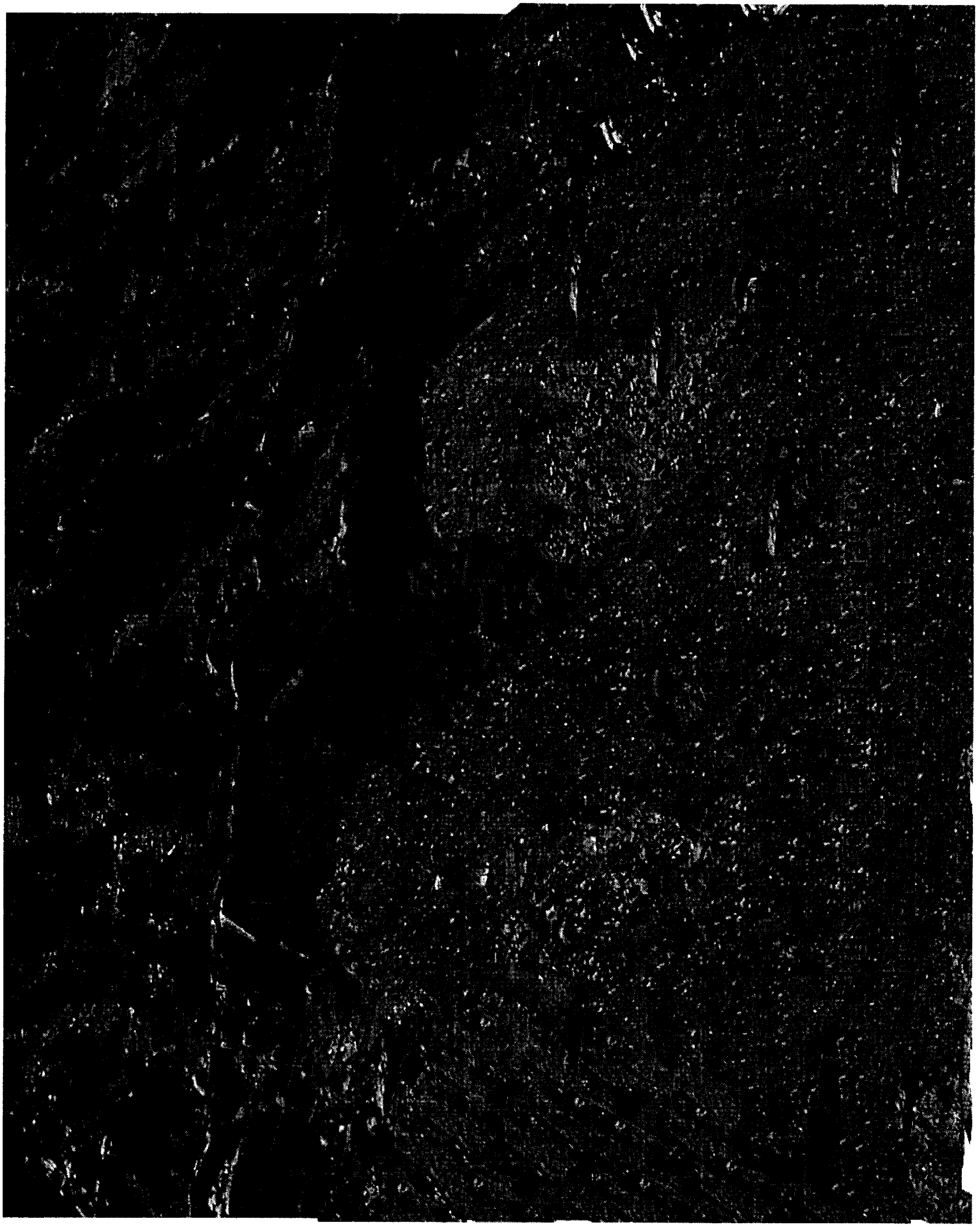
Information:

- Pre-SMRCA, Constructed in 1970
- Number of Portals - 3
- Location – Behind Shop and Material Shed


Existing Structures



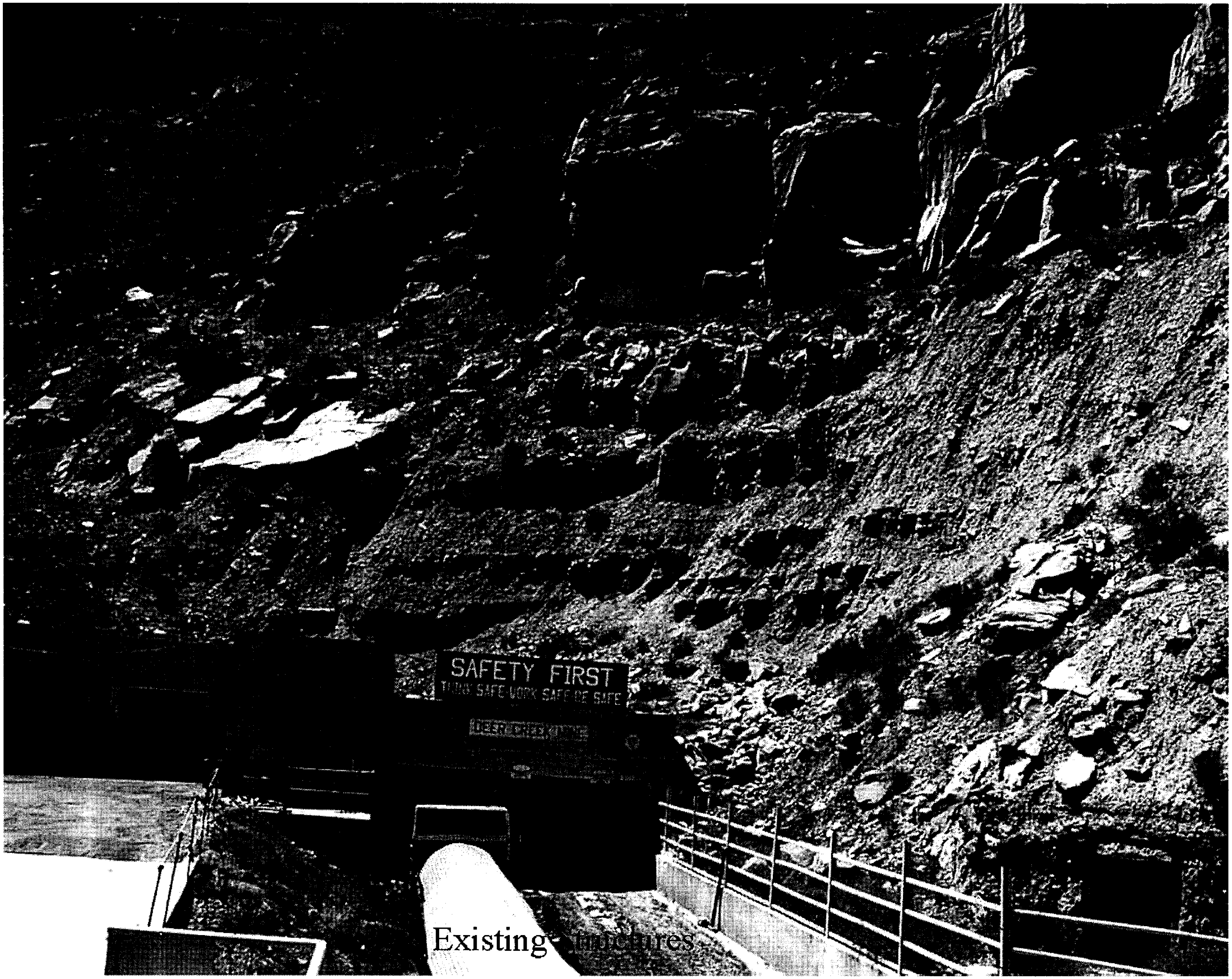




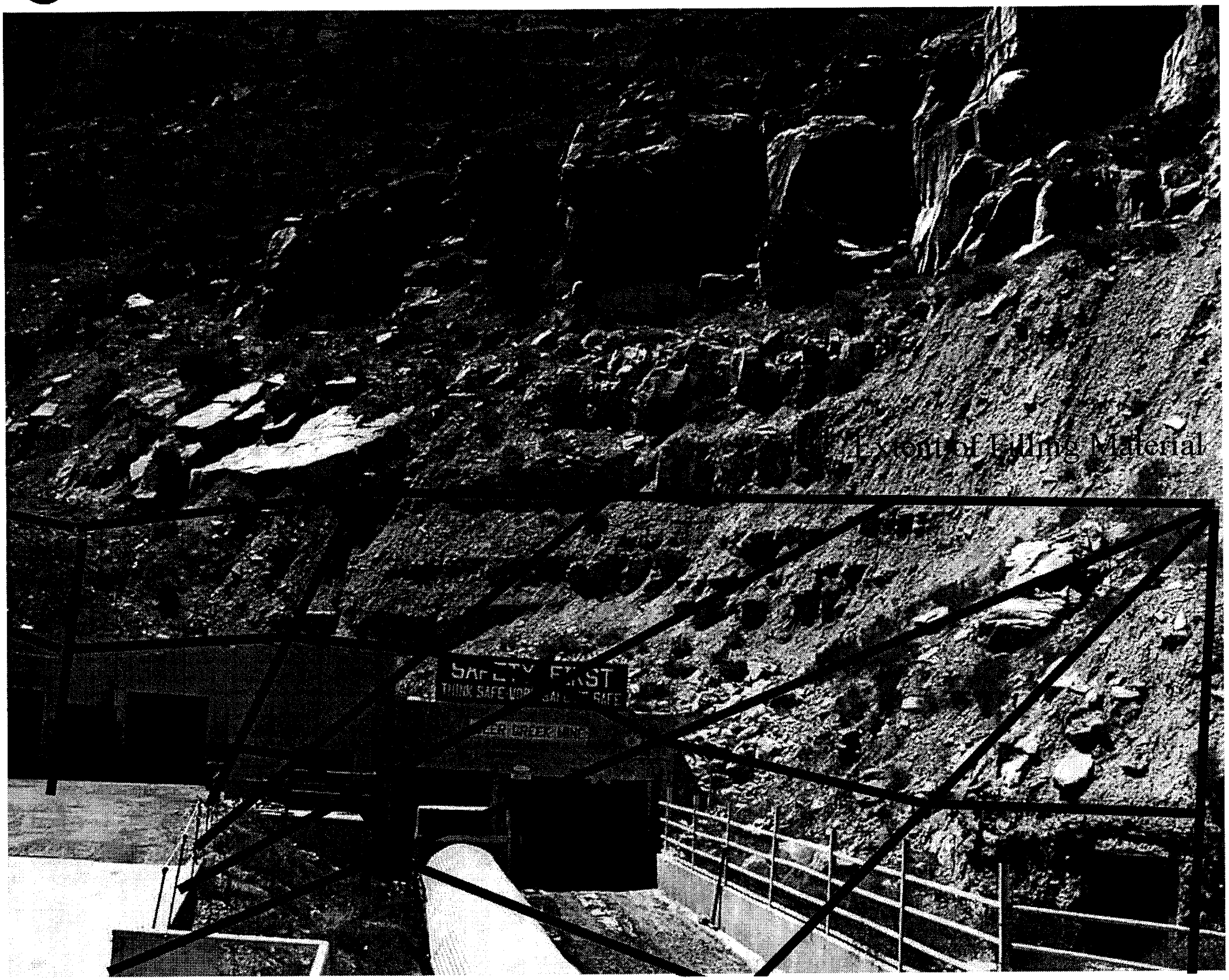
Belt Portal Area

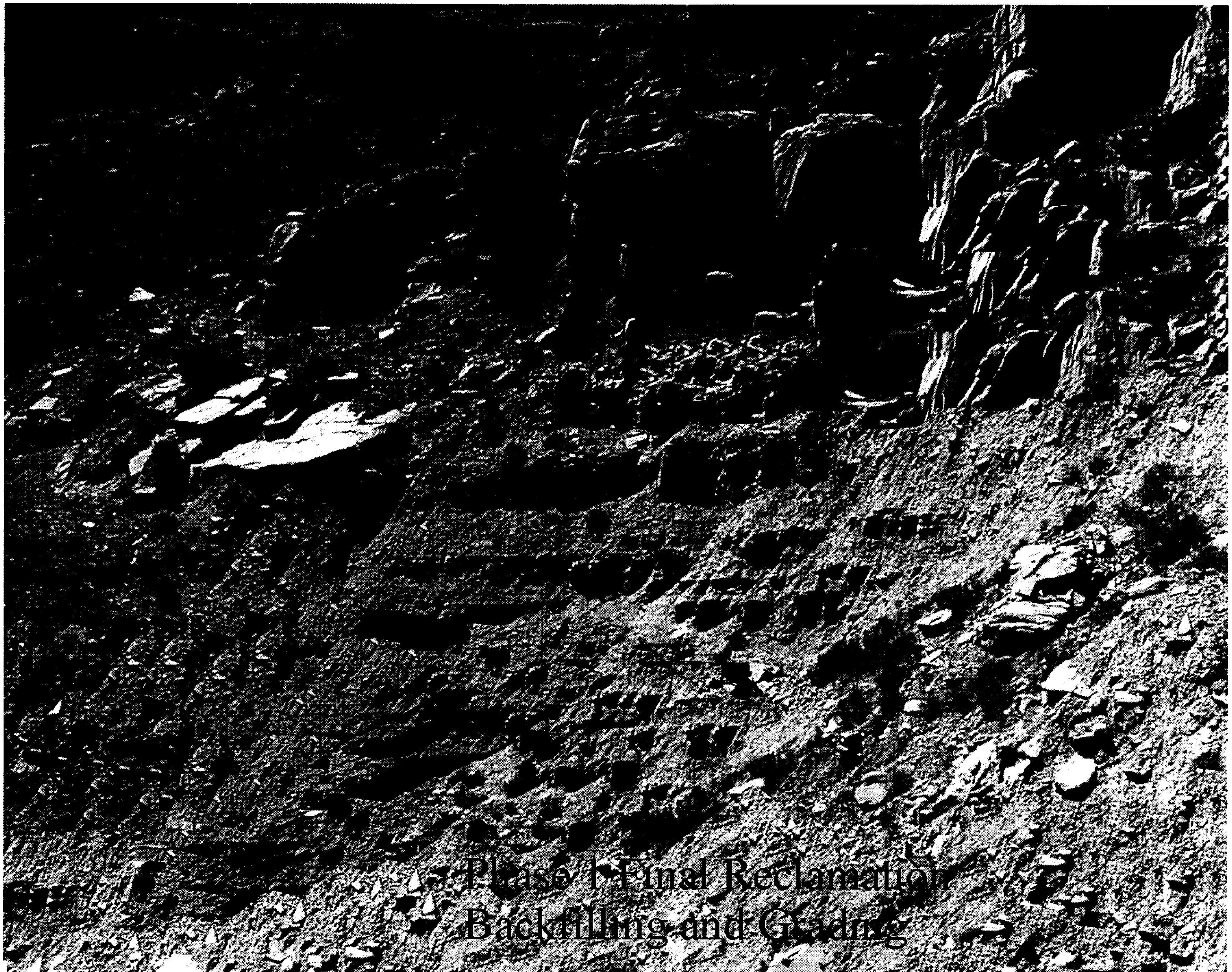
Information:

- Pre-SMRCA, Constructed in 1970
- Number of Shafts - 1
- Location – Behind Deer Creek Main Office Building



Existing Structures

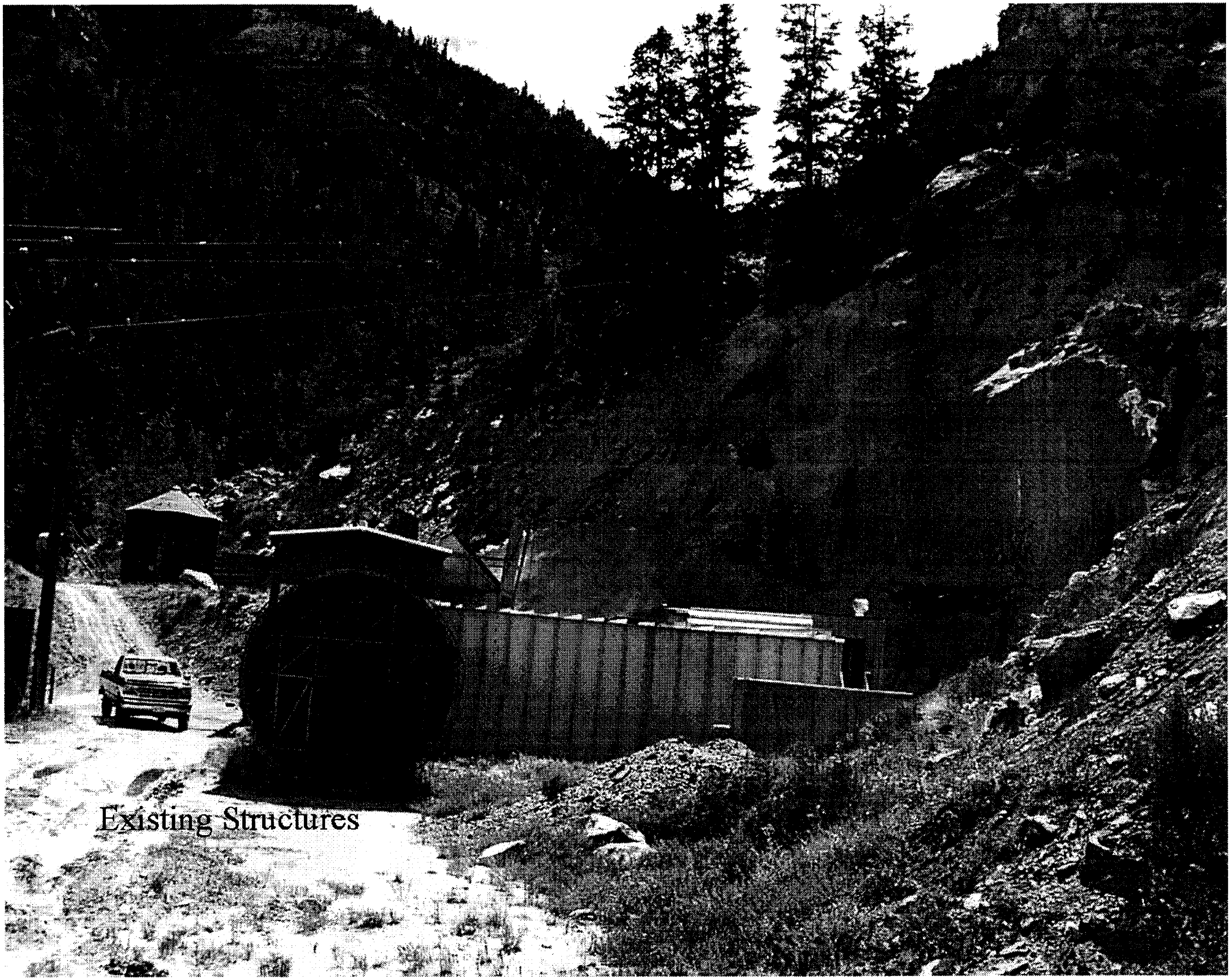

Extent of Failing Material
SAFETY FIRST

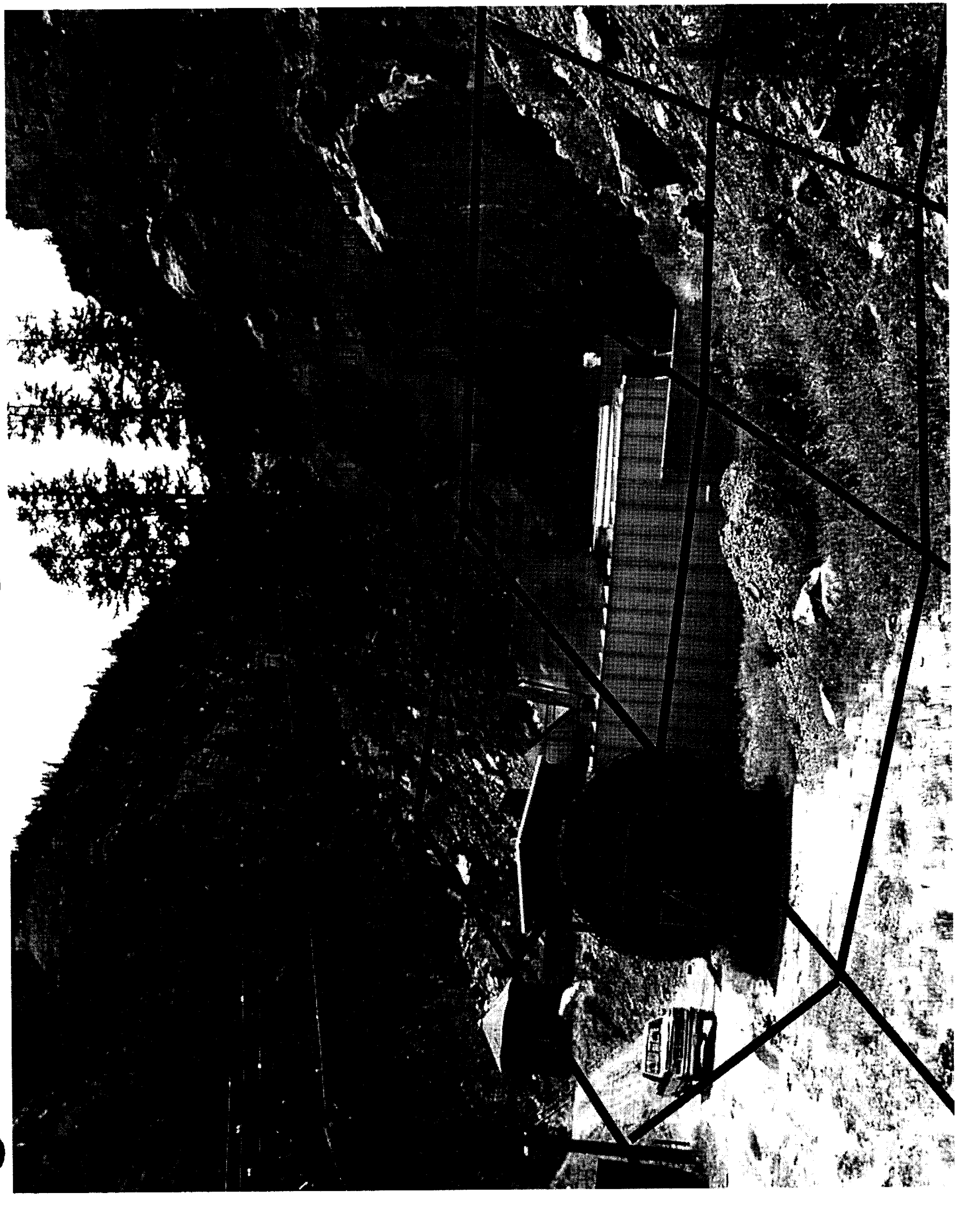

Phase I Final Reclamation
Backfilling and Grading

Main Fan Shaft Area

Information:

- Pre-SMRCA, Constructed in 1977
- Number of Shafts - 1
- Location – Above Deer Creek Main Office Building

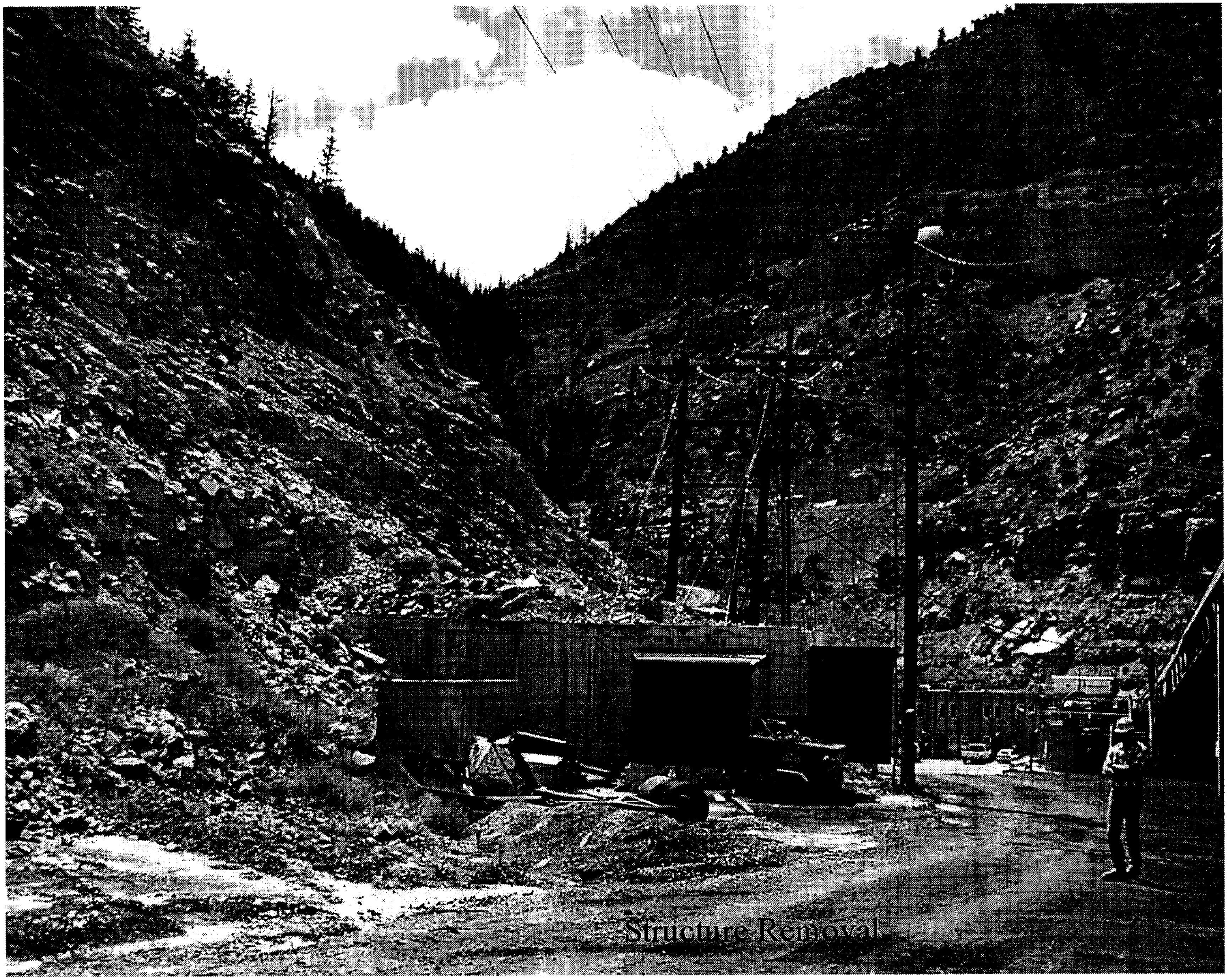

Existing Structures



Old McKinnon Fan Portal Area

Information:

- Pre-SMRCA, Constructed Pre-1970's
- Number of Portals - 2
- Location – South of ROM Beltline



Structure Removal


Extent of Fill


Structure Removal

Phase 1 of Final Reclamation
Backfilling and Grading

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Deer Creek Mine
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Mining and Reclamation Plan

Appendix R645-301-500-E

Slope Stability Analysis Report - RB&G Engineering

Geotechnical Investigation

Deer Creek Mine Reclamation Project

Carbon County, Utah

June 2000

R B & G E N G I N E E R I N G , I N C .

Professional Engineers

June 23, 2000

RB&G
ENGINEERING
INC.
1435 WEST 820 NORTH
PROVO, UT 84601-1343
801 374-5771 Provo
801 521-5771 SLC

Dennis Oakley
Energy West Mining Co.
P.O. Box 310
Huntington, UT 84526

Dear Mr. Oakley:

This report outlines the results of a geotechnical investigation performed for the Deer Creek Mine Reclamation Project near Huntington, Utah. The purpose of this investigation was to determine the characteristics of the subsurface material throughout the site and perform slope stability analyses such that design recommendations can be made with regard to the final slopes proposed for the reclamation project. Specific areas involved in the study include the mine fan area, intake portal area, waste rock storage areas 1 and 2, and at the coal bin area. The investigation has been completed in accordance with a written proposal submitted to your organization for the work, and the results of the investigation, along with pertinent recommendations for design, are outlined in the following sections of this report.

The information contained in the report is discussed under the following headings: (1) Geological and Existing Site Conditions, (2) Subsurface Soil and Water Conditions, and (3) Slope Stability Analysis and Recommendations.

1. GEOLOGICAL AND EXISTING SITE CONDITIONS

The Deer Creek Mine is locate in the Colorado Plateaus Physiographic Province. Bedrock in the area consists of upper Cretaceous age, Starpoint and Blackhawk Formations which generally consist of sandstone, shale, siltstone and coal seams. The coal seam were not exposed on the outcrops in this area due to old burns, which have left several red burnt zones. The bedrock is generally dipping approximately 3 to 5° in a northeasterly direction. Photo 1 shows an overview of the site from the west end.

Waste Rock Storage Area 1 (Drill Hole 1) consists of fill material with a flat pad on the top with steep slopes to the south as shown if Photo 2.

Sandstone bedrock forms ledges and cliffs while shaley zones form steep slopes to the north. The top pad is currently used for equipment and storage. There is no vegetation growing on top, with some natural grasses and brush along the southern slopes.

The Fan Area is located along the western edge of the study (Drill Holes 2 and 2A). This area consists of a small pad created by a combination of cut and fill into the bedrock and alluvium to the north. Shaley slopes and sandstone ledges and cliffs are exposed to the north with an alluvial slope to the south as shown in Photo 3. A very large sandstone boulder approximately 15 to 20 feet wide is located just west of Drill Hole # 2. The southern slope is covered with natural grasses and brush. Shotcrete has been sprayed along the steep cuts to the north to help stabilize the slope. Some ground-water was seeping from areas within the cut.

The Portal Area is located along the southern toe of the natural slopes. The roadway along this area has been cut back slightly into the slopes (Drill Holes 3, 4, 5 and 7) as shown in Photo 4. Along this section, mine portals have been cut into the hillside with a small concrete wall about 3 to 6 feet high along the toe of the slope. Shotcrete has been sprayed across the slopes near the portal entrances. Near the center of this area by Drill Hole 4 the colluvium along this slope is unstable and has been monitored for some sliding for several years. Reclamation in this area will lessen the steepness of this slope, making it stable.

Waste Rock Storage Area 2 is located at the southeast end of the study area (Drill Hole 6). This area consists of shaley slopes and sandstone cliffs to the west with the Elk Canyon stream channel beneath the existing fill and roadway to the east as shown in Photo 5. Very little vegetation is found growing on the highly coal covered slopes in this area

The study area is located within 20 miles of several active faults. The Joes Valley Fault zone is located less than 10 miles to the west, with the Pleasant Valley fault zone located less than 20 miles to the northwest. While current seismic data shows the mine to be located in a very seismically active area, many of the recorded earthquakes in the region have been attributed to rockbursts associated with coal mining and not deep tectonic events. Due to past and potential seismic activity this area is classified as being within Seismic Zone 2B, according to the 1997 edition of the Uniform Building Code (UBC).

Other than the information provided above, no conditions appear to exist at this site which would adversely effect foundation performance.

2. SUBSURFACE SOIL AND WATER CONDITIONS

A. FIELD INVESTIGATIONS

The characteristics of the subsurface material within the reclamation project area were defined by drilling 8 borings at the approximate locations shown in Figure 1. The test holes were drilled with a CME-55 rotary rig using water as the drilling fluid and a rock bit with NW drive casing to advance the holes through the overburden. Continuous coring of the bedrock was performed using an NQ core barrel.

During the subsurface investigation, sampling was performed at three- to five-foot intervals in the overburden throughout the depth investigated. Both disturbed and undisturbed samples were obtained during the field investigations. Disturbed samples were obtained by driving a 2-inch split spoon sampling tube through a distance of 18 inches using a 140-pound weight dropped from a distance of 30 inches. The number of blows to drive the sampling spoon through each 6 inches of penetration is shown on the boring logs. The sum of the last two blow counts, which represents the number of blows to drive the sampling spoon through 12 inches, is defined as the standard penetration value. The standard penetration value provides a good indication of the in-place density of sandy material; however, it only provides an indication of the relative stiffness of the cohesive material, since the penetration resistance of materials of this type is a function of the moisture content. Considerable care must be exercised in interpreting the standard penetration value in gravelly-type soils, particularly where the size of the granular particle exceeds the inside diameter of the sampling spoon. If the spoon can be driven through the full 18 inches with a reasonable core recovery, the standard penetration value provides a good indication of the in-place density of gravelly-type material.

Miniature vane shear tests, which provide an indication of the undrained shearing strength of cohesive materials, were performed on samples of the clay soil during the field investigations. The results of these tests are shown on the boring logs as the torvane value in tsf.

Undisturbed samples were obtained by pushing a thin-walled sampling tube into the subsurface material using the hydraulic pressure on the drill rig. The location at which the undisturbed samples were obtained are shown on the boring logs.

Continuous coring was performed in the bedrock. The cores were characterized by determining the percent recovery and the Rock Quality Designation (RQD) for each core interval. Both the percent recovery and the RQD are shown on the boring logs. The RQD is defined as the percent of material within the core interval which has core lengths greater than 4 inches.

The location and depth of the 8 borings are summarized below:

TEST HOLE NO.	AREA	LOCATION	DEPTH
1	WASTE ROCK STORAGE AREA 1 (fill)	STA. 14+00 / DEER CREEK DRAINAGE	26.5'
2	MINE FAN AREA	STA. 28+00 / DEER CREEK DRAINAGE	11.5'
2A	MINE FAN AREA	STA, 27+25 / DEER CREEK DRAINAGE	31'
7	PORTAL AREA	STA. 24+00 / DEER CREEK DRAINAGE	18.5'
3	BELT PORTAL AREA	STA. 22+00 / DEER CREEK DRAINAGE	26'
4	PORTAL AREA	STA. 21+00 / DEER CREEK DRAINAGE	32'
5	PORTAL AREA	STA. 0+00 / DEER DRAINAGE	19'
6	WASTE ROCK STORAGE AREA 2 COAL STORAGE PAD	STA. 5+00 / ELK CANYON DRAINAGE	45.5'

The logs for the eight borings are presented in the Test Hole Log section of this report, and are discussed separately below for each area:

(1) Mine Fan Area (Sta. 27+25 - 28+00, Deer Creek Drainage)

The characteristics of the subsurface material in this area were defined by drilling two borings (DH2 and DH2A) to depths of 11.5 and 31 feet, respectively. The location of these borings are shown in plan view on Figure 1 and in profile view in Figure2. It will be observed from the boring logs that the soil profile consists of interbedded layers of sandy clay with gravel, clayey gravel with sand, and silty sand with sandstone boulders. The results of the standard penetration tests indicate that the granular materials are in a relatively dense condition. The results of standard penetration and miniature vane shear tests indicate that the cohesive soils are in a firm to stiff condition. No groundwater was encountered within 31.5 feet investigated at the time drilling was performed (April 2000).

(2) Portal Area (Sta. 21+00 - 25+00, Deer Creek Drainage, & Sta. 0+00, Deer Drainage)

The characteristics of the subsurface material in this area were defined by drilling four borings (DH7, DH3, DH4, and DH5) to depths varying from 18.5 to 32 feet. The location of these borings is shown in plan view on Figure 1 and in profile view in Figures 3 through 6. It will be observed from the boring logs that the soil profile in Test Holes 3, 4 and 7 is similar consisting predominantly of interbedded layers of sandy clay with gravel and clayey gravel with some coal and sandstone rock fragments. Bedrock was encountered at a depth of 21 feet in Test Hole 4. The granular material varies from medium dense to dense, and the cohesive soil ranges from soft to stiff. Bedrock, consisting of siltstone and mudstone, was encountered in Test Hole 5 at a depth of 5 feet. The soil above 5 feet consisted of clay and coal with sandstone gravel fragments in a relatively stiff condition. The bedrock from 6 to 19 feet was cored, resulting in a recovery ranging from 90 to 97% and a RQD varying from 23 to 80. Water was measured at a depth of 11.4 feet below the ground surface in Test Hole 4 two hours after drilling, and at 7 feet below the ground surface in Test Hole 7. The water level in Test Hole 5 was near the surface after drilling.

(3) Waste Rock Storage Area 1 (Sta. 14+00, Deer Creek Drainage)

The characteristics of the subsurface material in this area were defined by drilling one boring (DH1) to a depth of 26.5 feet. The location of this boring is shown in plan view on Figure 1 and in profile view in Figure 7. It will be observed from the boring log that the soil profile consists of lean clay with gravel and clayey gravel, with sandstone and coal fragments, which appears to be fill. The granular material varies from medium dense to dense, and the clay appears to be in a relatively stiff condition. No groundwater was encountered in this test boring.

(4) Waste Rock Storage Area 2 (Sta. 1+00 - 6+00, Elk Canyon Drainage)

The characteristics of the subsurface material in this area were defined by drilling one boring (DH6) to a depth of 46.5 feet. The location of this boring is shown in plan view on Figure 1 and in profile view in Figure 8. It will be observed from the boring log that the soil profile consists of interbedded sandy clay, coal and clayey gravel with cobble and boulder size rock in the lower portion of the profile. This material appears to be fill with wood debris encountered at some locations. Groundwater was encountered at a depth of about 42.5 feet in this boring.

B. LABORATORY TESTING

Each sample obtained in the field was classified in the laboratory according to the Modified Unified Soil Classification System. The symbol designating the soil type according to this system, is presented on the boring logs. A description of the Modified Unified Soil

Classification System is presented in the Test Hole Log section, and the meaning of the various symbols shown on the boring logs can be obtained from this figure. It will be observed that the sandy material classifies as SC, SM, and SP-type material, and that the gravelly soils classify predominantly as GC-type material with some GM and GP. The cohesive soil is a lean clay classifying predominantly as CL-type material.

Laboratory tests performed during this investigation to define the characteristics of the subsurface material throughout the proposed site included in-place dry unit weight, natural moisture content, Atterberg Limits, mechanical analyses, and direct shear tests. A summary of all laboratory tests performed during this investigation, with the exception of the direct shear tests, is presented on Table 1 Summary of Test Data in the Laboratory Testing section of this report.

It will be noted from Table 1 that the in-place dry unit weight of samples tested on the cohesive soil obtained from Test Holes 3 and 4 is 100.7 and 98.3 pcf, respectively. The natural moisture content of the cohesive material ranges from 13.4 to 20.7%. The liquid limit ranges from 18 to 31, and the plasticity index varies from non-plastic to 13. The natural moisture content of the granular material ranges from 5.8 to 14.7%, with between 13 and 33% in the silt and clay size range.

Two consolidated undrained direct shear tests were performed on samples of the cohesive material obtained from Test Holes 3 and 4 at depths of 12 and 15 feet, respectively. The results of these tests are presented in the Laboratory Testing section. It was not feasible to cut undisturbed ring samples from the sample obtained in Test Hole 3, due to sand and small gravel fragments. The sample was sieved and the minus No. 4 material was remolded and placed into the direct shear apparatus at the approximate dry unit weight of the sample obtained from the test boring. It was possible to cut rings for the direct shear tests from the undisturbed sample obtained from Test Hole 4. Both samples were saturated prior to testing. It will be observed from the direct shear charts that a friction angle of 31.2° with a cohesion of 2 psi was obtained for the sample from Test Hole 3, and a friction angle of 41.3° and a cohesion of 2 psi was obtained for the sample from Test Hole 4.

3. SLOPE STABILITY ANALYSES AND RECOMMENDATIONS

The stability analyses have been performed using a computer model of Spencer's Method known as UTEXAS 2. Spencer's Method satisfies both force and moment equilibrium and is considered to be a satisfactory method of solving slope stability problems. The analyses are included in the appendix and the results of the analysis for each area are discussed separately below as follows:

A. MINE FAN AREA (STA. 28+00, DEER CREEK DRAINAGE)

Figure 2 shows the existing and proposed final ground surface at Station 28+00. It will be observed that the plan includes backfilling and flattening the slope adjacent to the portal entry area and removing fill from the downhill side of the existing pad. The soil profile defined by Test Hole 2A consists of interbedded layers of sandy clay with gravel, clayey gravel with sand, and silty sand with sandstone boulders. The granular materials are in a relatively dense condition, and the cohesive material varies from firm to stiff. The strength parameters from the direct shear test for the cohesive material in Test Hole 3 are considered conservative for this are and have been used in the slope stability analysis. The total stress analysis performed for the slope results in a factor of safety of 2.05 as shown in Figure 2. It is our understanding that a drainage layer is planned beneath the backfill adjacent to the portal slope to intercept perched water which may exist in the slope and prevent pore pressures from developing within the fill. It is our opinion that the proposed reclaimed slope will be stable as designed.

B. PORTAL AREA (STA. 24+00, 23+00 & 21+00, DEER CREEK DRAINAGE)

Figures 3, 4, and 5 show the existing and proposed final ground surface at Stations 24+00, 23+00, and 21+00. A slope stability analysis has been performed for Station 21+00, and the results are shown in Figure 1. It will be observed from this figure that a finished slope of 2 horizontal to 1 vertical is proposed for this area. The strength parameters obtained from the remolded sample in Test Hole 3 have been assumed for the slope, resulting in a factor of safety of 2.3, as shown in Figure 5. It will be observed from Figures 3 and 4 that the finished slope will vary from about 3.5 horizontal to 1 vertical, to 7.5 horizontal to 1 vertical at Stations 24+00 and 23+00. The soil profile in Test Holes 3 and 7 is similar consisting predominantly of interbedded layers of sandy clay with gravel and clayey gravel with some coal and sandstone rock fragments. It is obvious that these slopes will be stable with a factor of safety in excess of 2.

C. PORTAL AREA (STA. 0+00, DEER DRAINAGE)

Figure 6 shows the existing and proposed final ground surface at Station 0+00 of the Deer Drainage. Test Hole 5 identifies a 5 foot clay with coal and sandstone gravel fragments layer, underlain by bedrock. A friction angle of 31° and a cohesion value of 100 psf has been assumed for this layer. The hillside and proposed backfill has been assumed to be a clayey gravel with strength parameters similar to those obtained from the direct shear test for Test Hole 3. The proposed slope of the backfilled area is about 1.5 horizontal to 1 vertical. It will be observed that a factor of safety of 1.46 was obtained for the finished slope. Flattening the slope to 1.75 horizontal to 1 vertical increases the factor of safety to greater than 1.5. If a drainage layer is installed beneath the proposed fill in this area to intercept any perched water from the natural slope, it is our opinion that the 1.5:1 slope will be satisfactory.

D. WASTE ROCK STORAGE AREA 1 (STA. 13+00, DEER CREEK DRAINAGE)

It will be observed that the reclamation effort in this area will include a cut and fill operation, resulting in a finished slope of about 3 horizontal to 1 vertical. The soil profile in Test Hole 1 consists of lean clay with gravel and clayey gravel, with sandstone and coal fragments, which appears to be fill. The granular material varies from medium dense to dense, and the clay appears to be in a relatively stiff condition. It will be observed from Figure 7 that a factor of safety of 2.3 was obtained, which is entirely satisfactory for this area.

E. WASTE ROCK STORAGE AREA 2 (STA. 5+00, ELK CANYON DRAINAGE)

Figure 8 shows the existing and proposed final ground surface at Station 5+00 of the Elk Canyon Drainage. It will be observed from this figure that a cut and fill operation is proposed, resulting in a finished slope of 2 horizontal to 1 vertical. The soil profile in Test Hole 6 consists of interbedded sandy clay, coal and clayey gravel with cobble and boulder size rock in the lower portion of the profile. This material appears to be fill with wood debris encountered at some locations. A friction angle of 31° and a cohesion of 100 psf has been used in the analysis for the fill, resulting in a factor of safety of 1.58. It is our understanding that a drainage layer will also be placed beneath the fill in this area. It is our opinion that the proposed design will be stable with an adequate factor of safety.

F. WASTE ROCK STORAGE AREA 2 (STA. 2+00, ELK CANYON DRAINAGE)

It will be observed from Figure 9 that a substantial fill is planned for this area. We understand that the material to be used in the proposed fill will be primarily concrete and asphalt debris. An assumed friction angle of 38° and 0 cohesion has been used for this material in the analysis. It has been assumed that the underlying soil will consist of clayey gravel and gravelly clay, and a friction angle of 31° and 100 psf cohesion has been used for this material. A factor of safety of

1.2 was obtained for the proposed slope of 1.5 horizontal to 1 vertical. Flattening the fill slope to 1.75 horizontal to 1 vertical, results in a factor of safety of 1.36. It is recommended that the finished slope be 1.75 horizontal to 1 vertical, or flatter.

It is recommended that all fill material, excluding the concrete and asphalt debris, be placed in lifts not exceeding 1 foot in thickness and compacted to an in-place unit weight equal to at least 90% of the maximum laboratory density as determined by ASTM D 698. It is recommended that the concrete and asphalt debris be placed in lifts not exceeding 2 feet in thickness and compacted using 4 passes of a 10-ton vibratory roller, or equivalent.

The conclusions and recommendations presented in this report are based upon the results of the field and laboratory tests, which in our opinion, define the characteristics of the subsurface material throughout the site in a satisfactory manner. It should be recognized that soil materials are inherently heterogeneous and that conditions may exist throughout this site which could not be defined during this investigation. If during construction, conditions are encountered which appear to be different than those presented in this report, it is requested that we be advised in order that appropriate action may be taken.

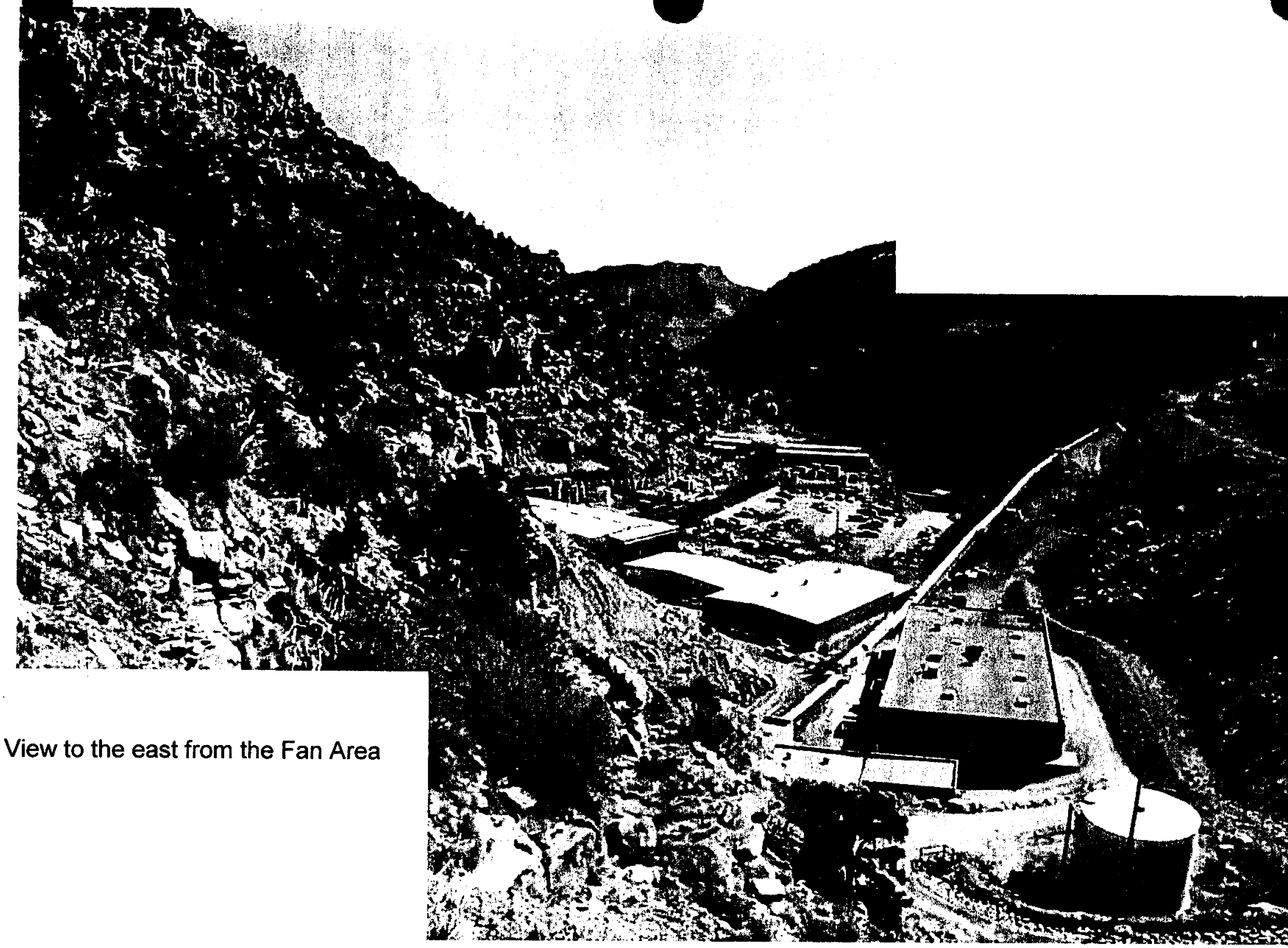
Sincerely,

RB&G ENGINEERING, INC.

REGISTERED PROFESSIONAL ENGINEER
NO.162291
BRADFORD E.
PRICE
7/6/00
STATE OF UTAH

Bradford E. Price, P.E.
bep/jag

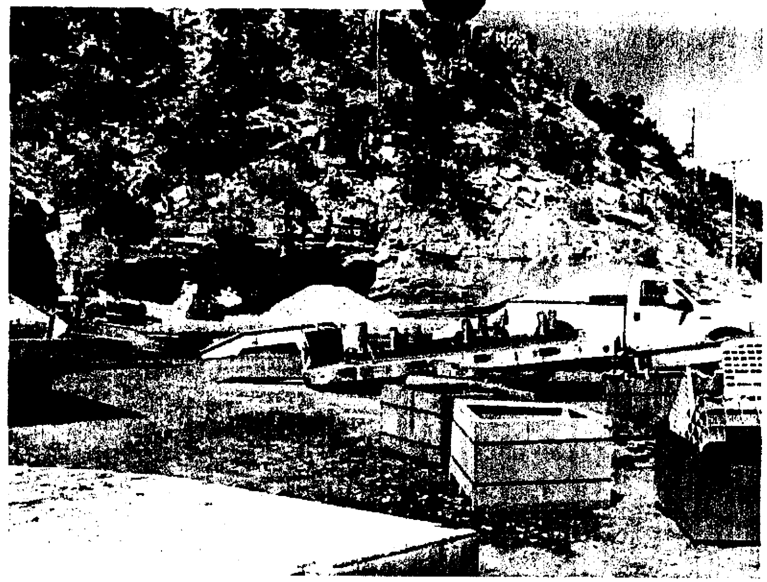
Photograhps



View to the east from the Fan Area

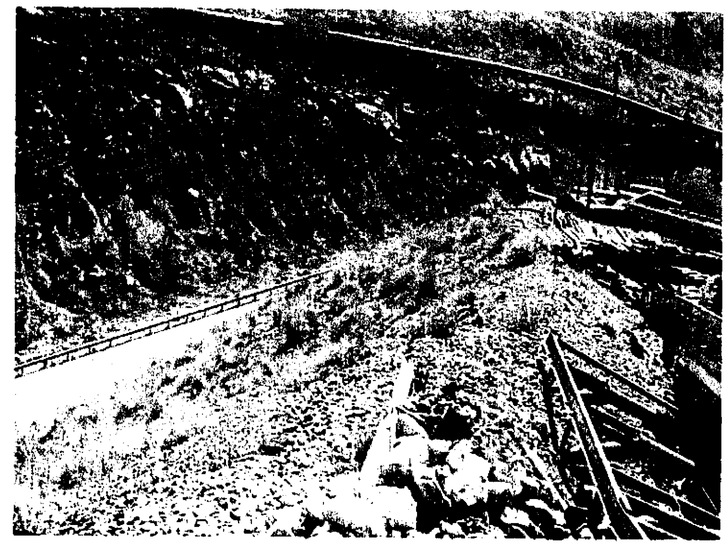
RB&G ENGINEERING INC.
Provo, Utah

Photo 1 Site Conditions
Deer Creek Mine
Carbon County, Utah



Top of Pad looking northeast

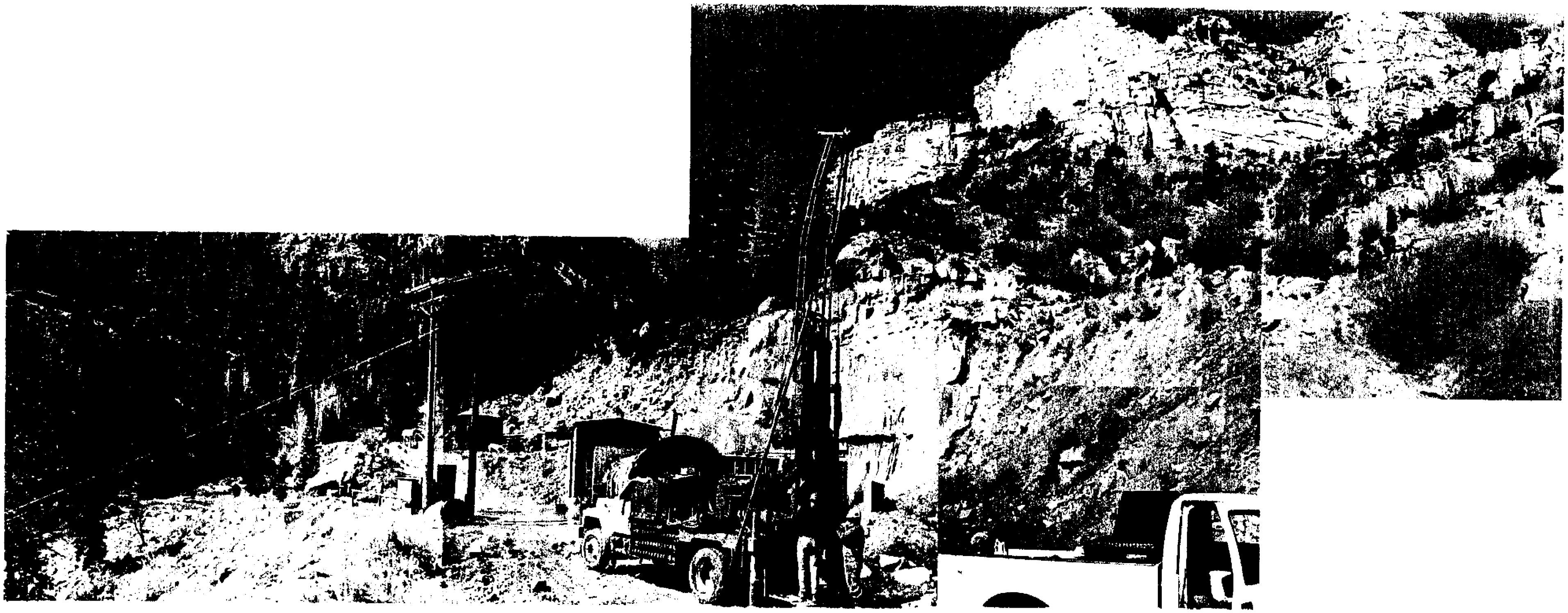
View down slope to the east



View down slope to the southwest

RB&G ENGINEERING INC.
Provo, Utah

Photo 2 Site Conditions Waste Rock Storage Area 1
Deer Creek Mine
Carbon County, Utah



Fan Area View to the west,
Drill on Hole # 2A

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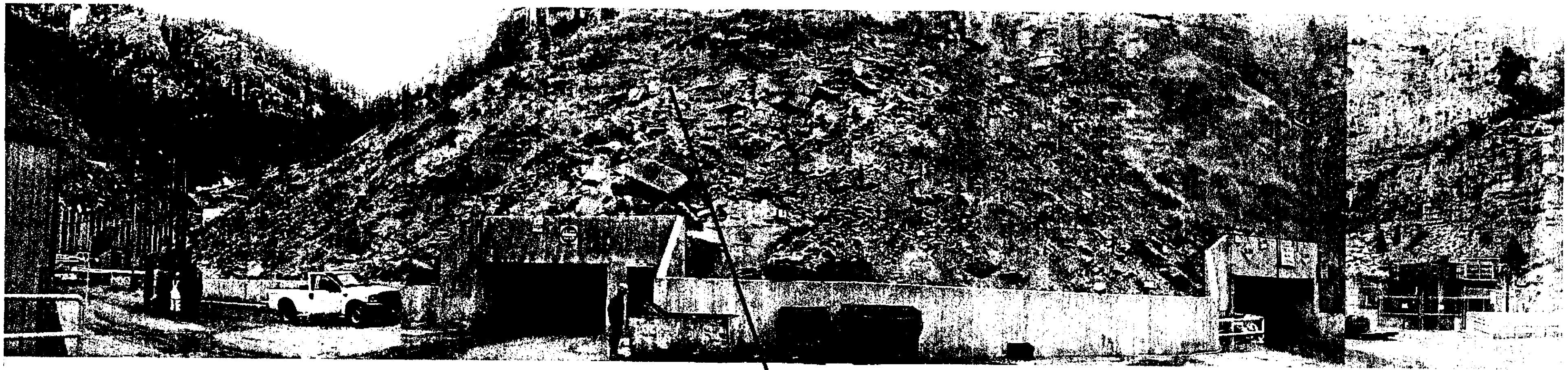
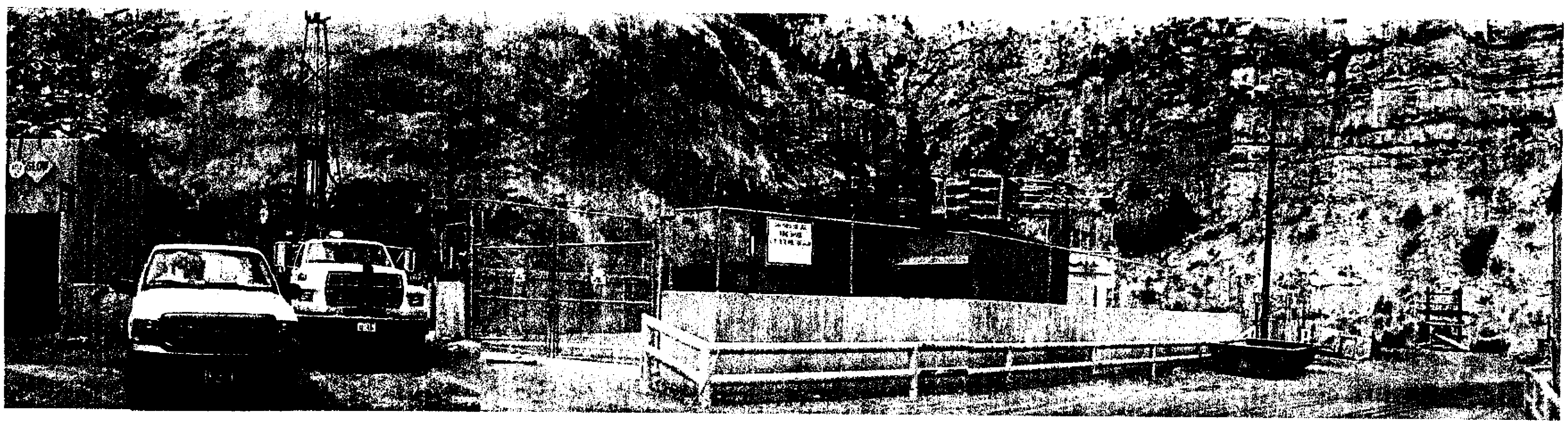
Provo, Utah

Photo 3 Site Conditions Fan Area
Deer Creek Mine
Carbon County, Utah



Portal Area View from southwest to northwest
Drill on Hole #4

Slide Area



Drill Hole # 5

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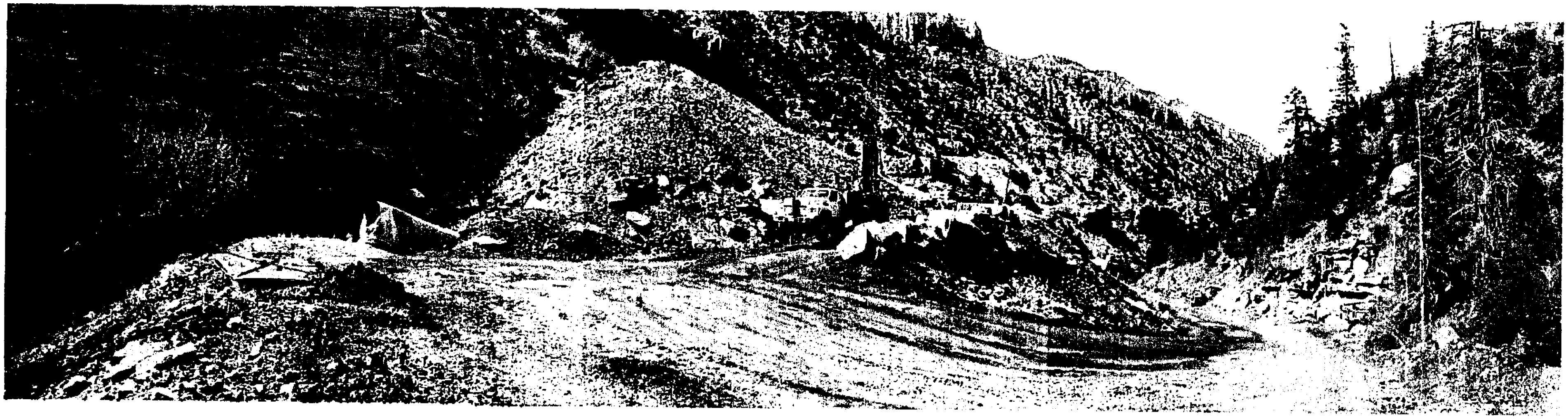
Photo 4 Site Conditions Portal Area
Deer Creek Mine
Carbon County, Utah



Waste Rock Storage Area 2 View to the north
Drill on Hole #6

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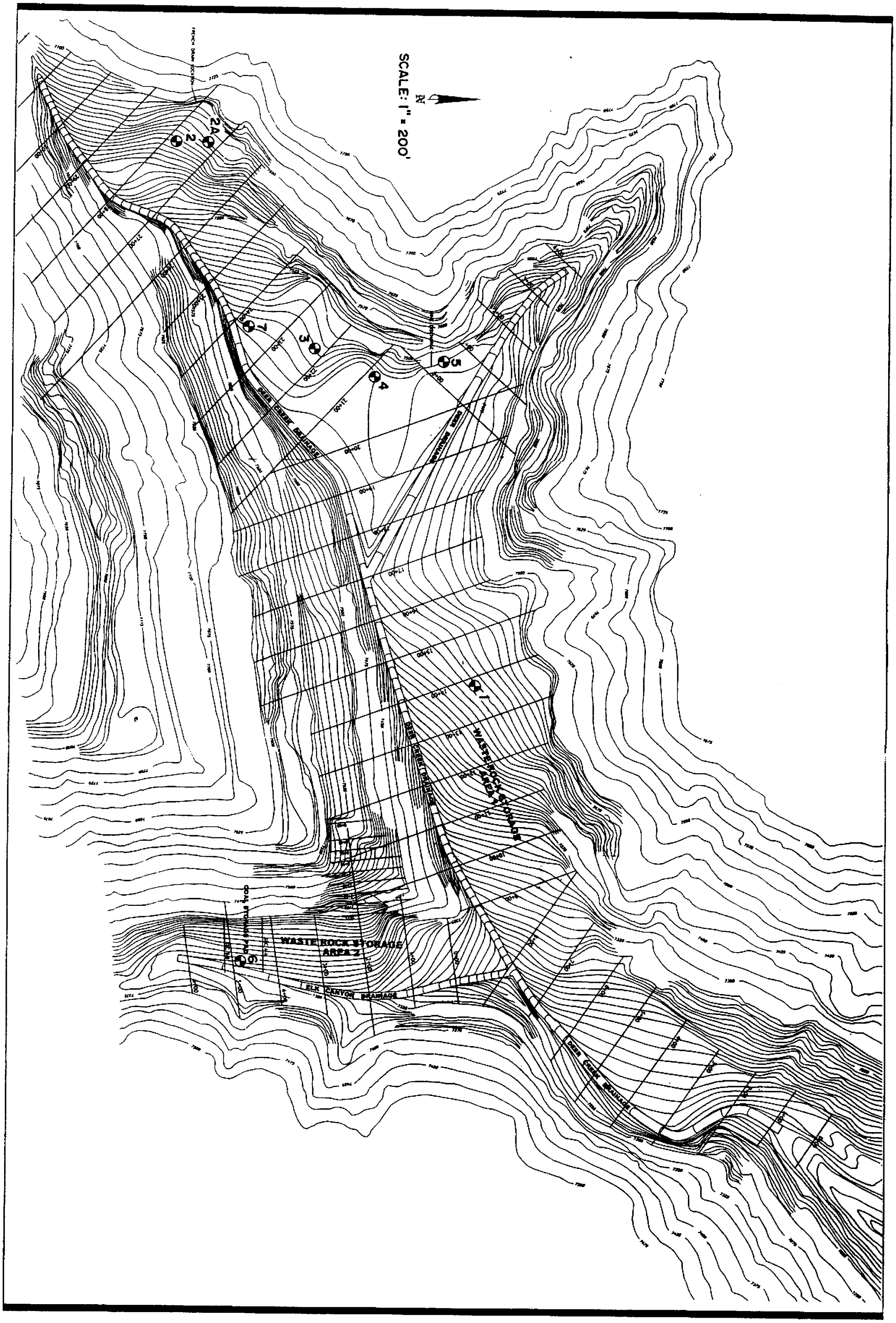
Provo, Utah

Photo 5 Site Conditions Waste Rock Storage Area 2
Deer Creek Mine
Carbon County, Utah

Figures



Figure

RB&G ENGINEERING INC.
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DEER CREEK MINE RECLAMATION PROJECT
Huntington, Utah

Site Plan & Test Hole Locations

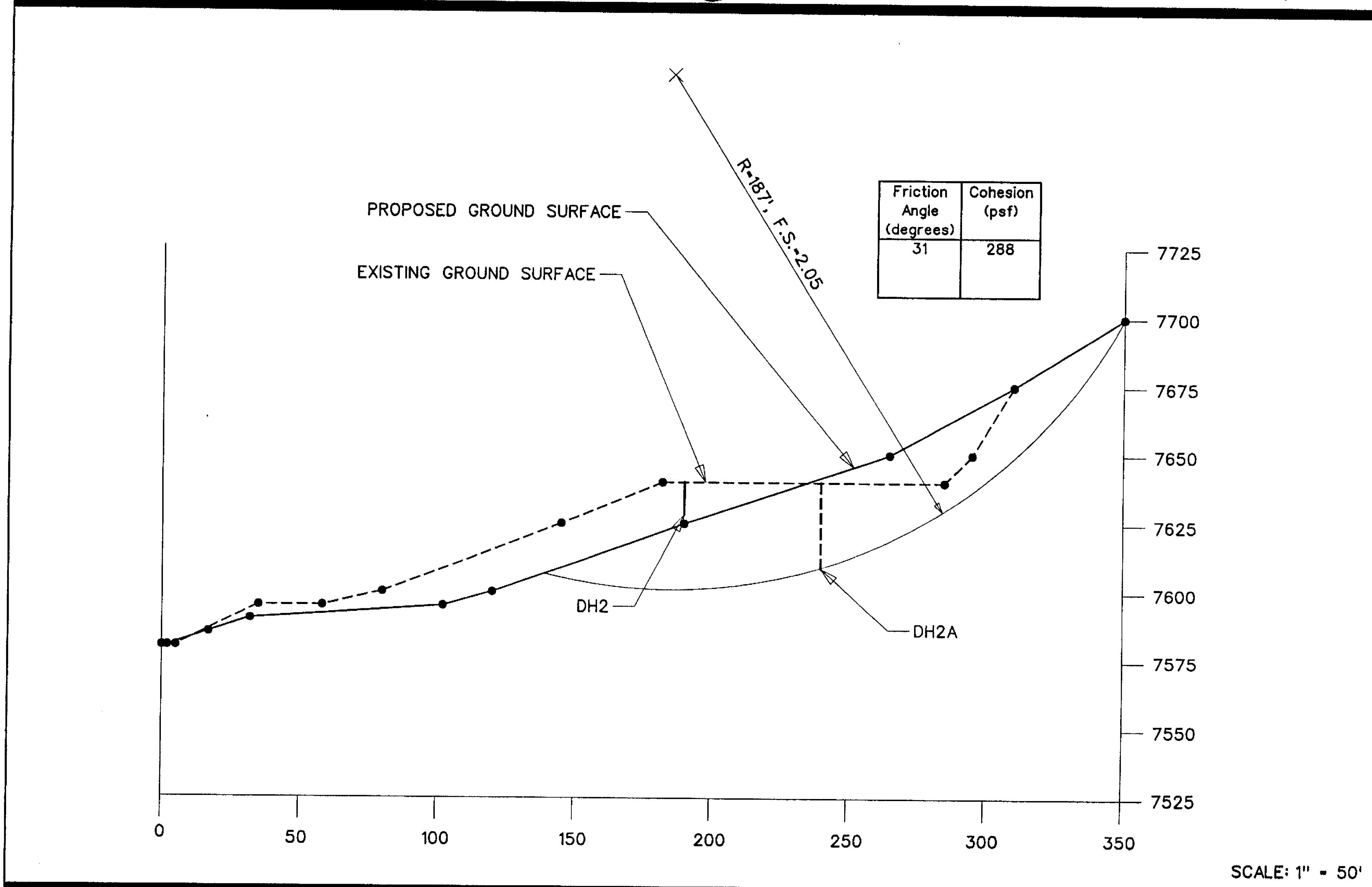

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Figure 2 SLOPE STABILITY ANALYSIS
STA. 28+00, DEER CREEK DRAINAGE (MINE FAN AREA)

Deer Creek Mine Reclamation Project
Huntington, Utah

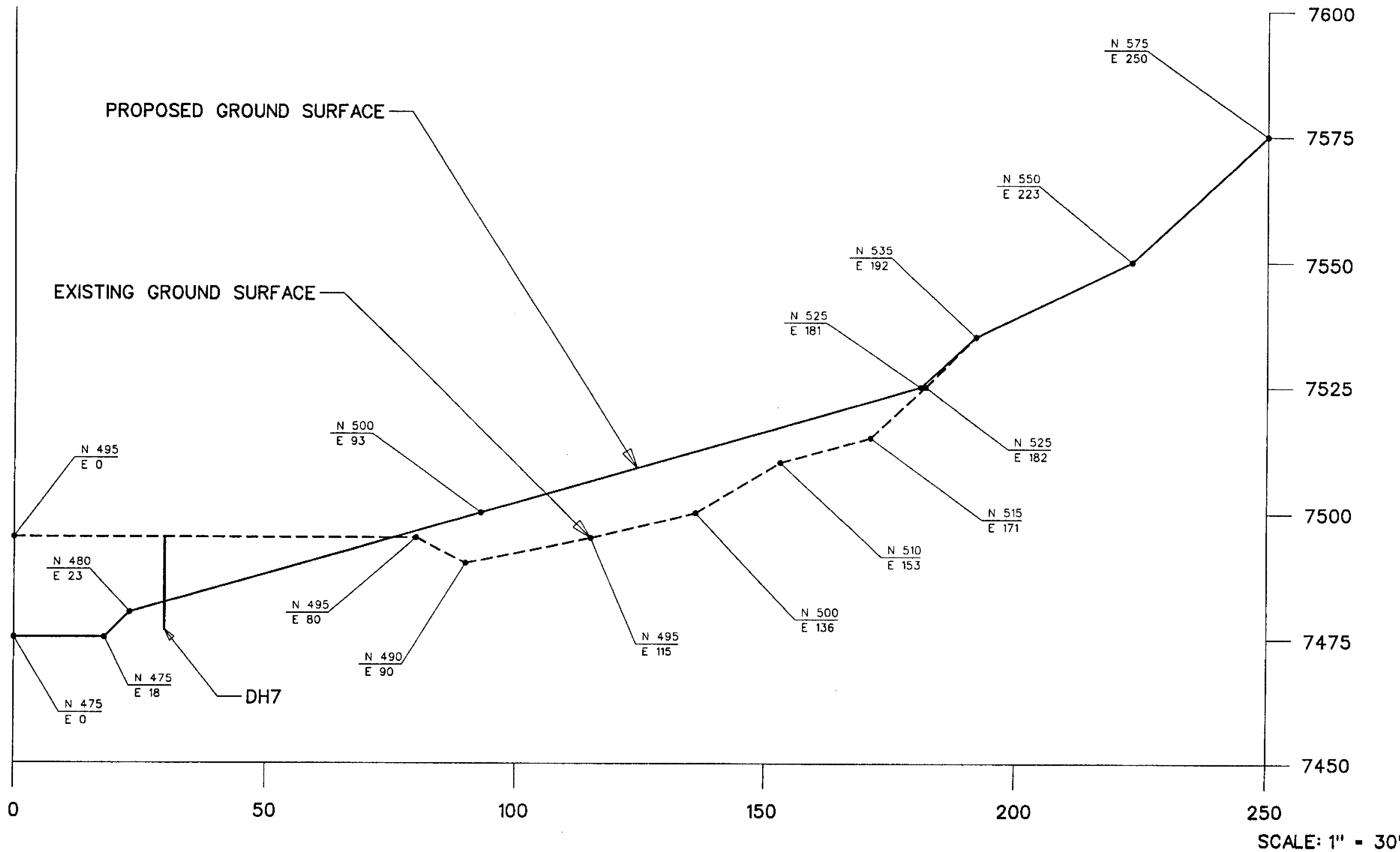

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Figure 3 SLOPE STABILITY ANALYSIS
STA. 24+00, DEER CREEK DRAINAGE (BELT PORTAL)

Deer Creek Mine Reclamation Project
Huntington, Utah

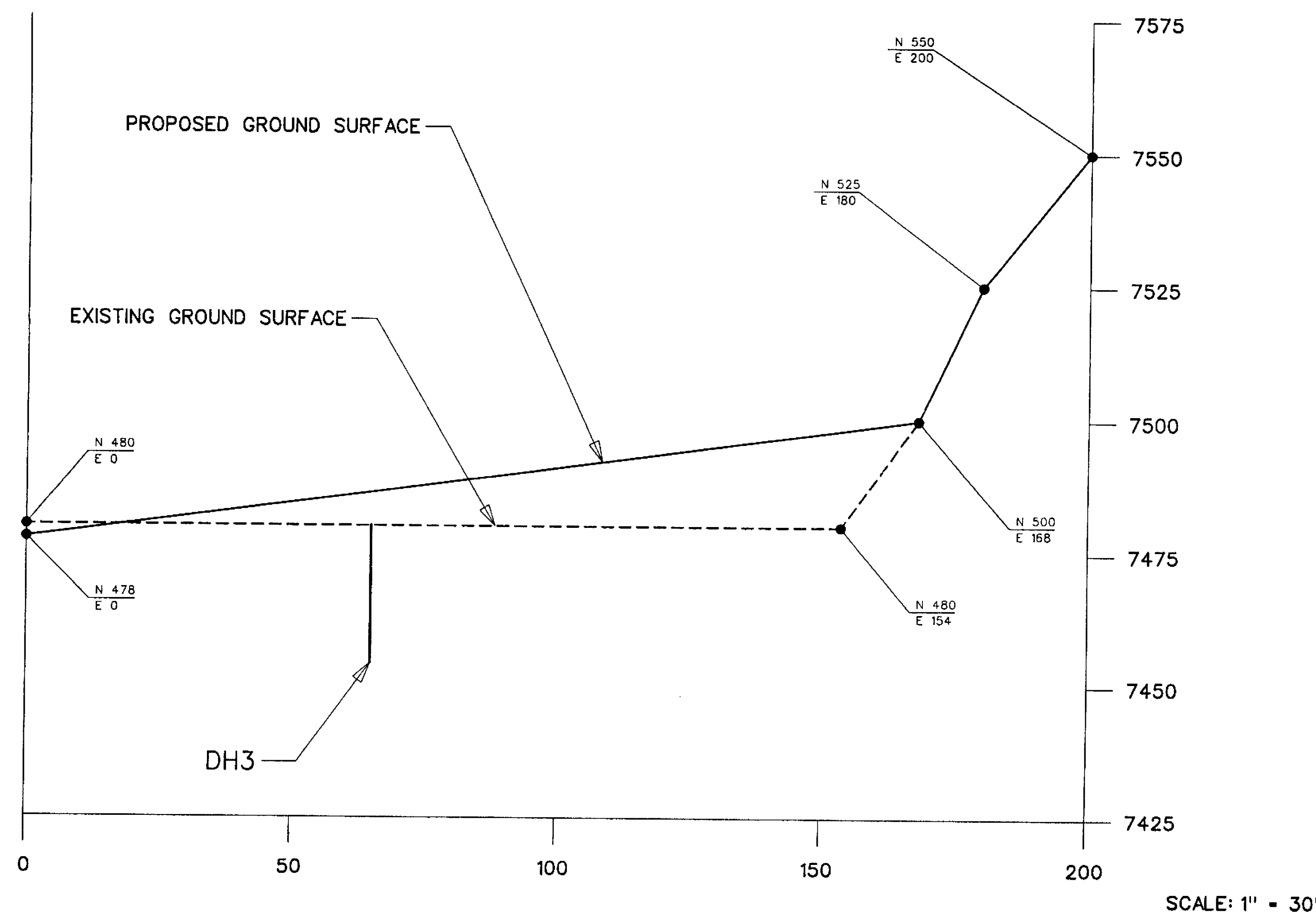

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Figure 4 SLOPE STABILITY ANALYSIS
STA. 23+00, DEER CREEK DRAINAGE (BELT PORTAL)

Deer Creek Mine Reclamation Project
Huntington, Utah

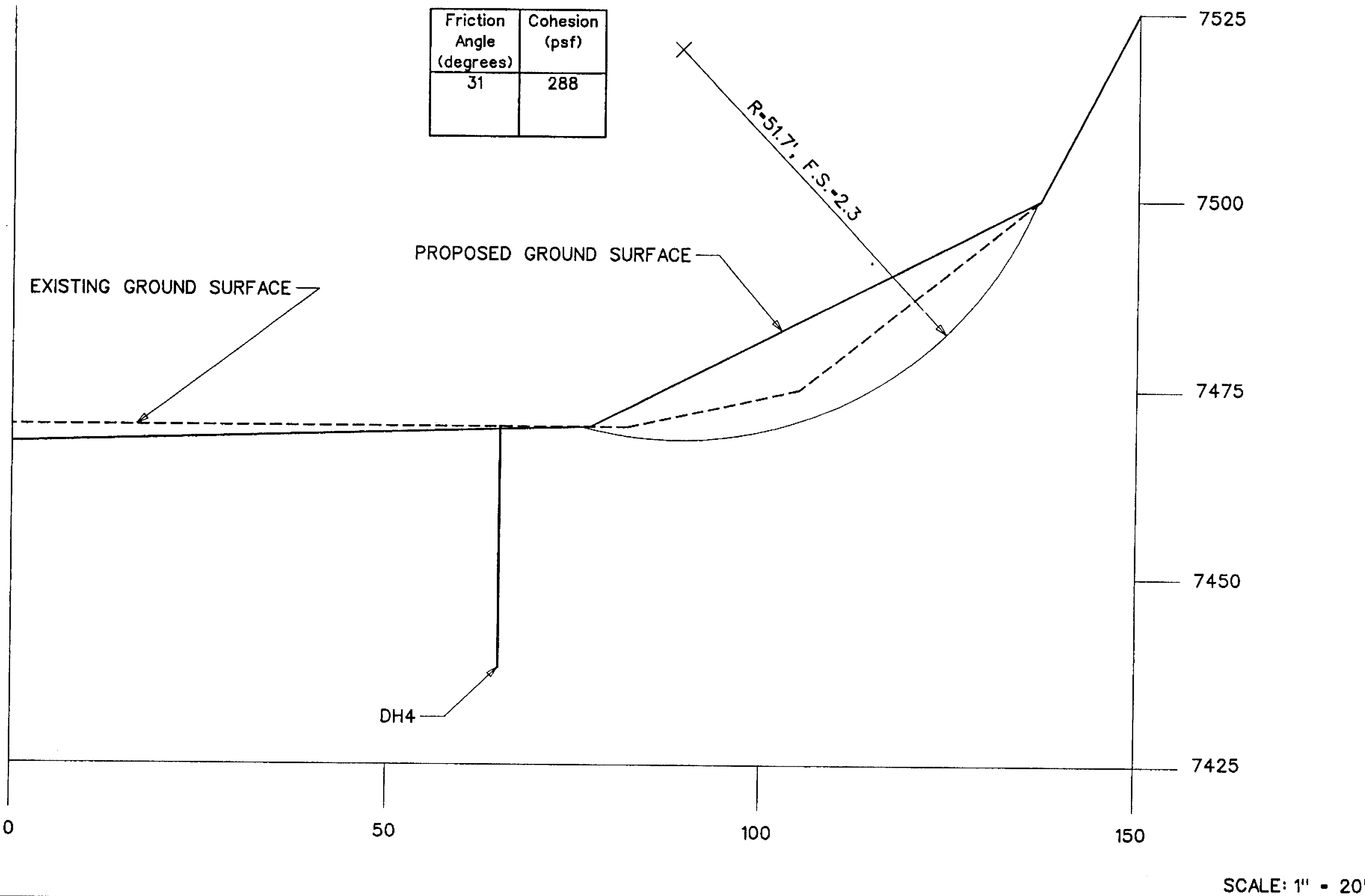

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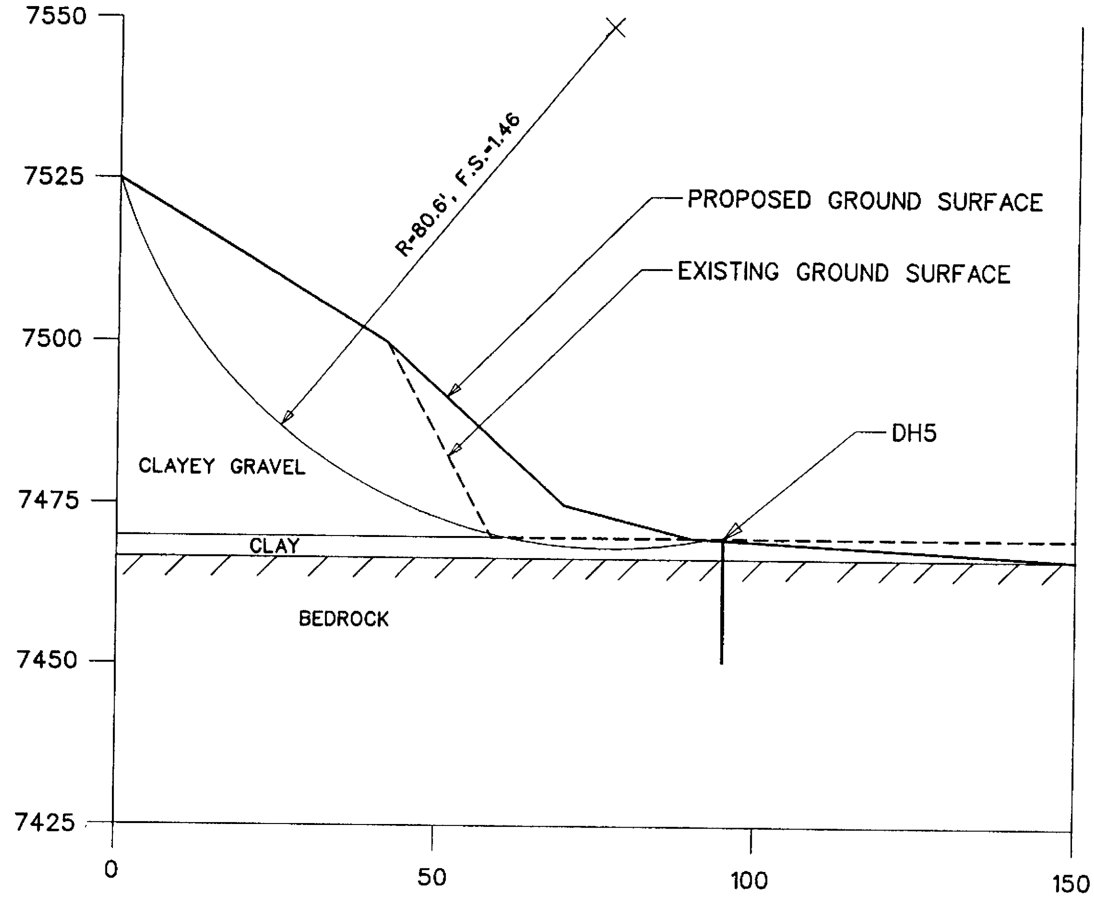
Figure 5 SLOPE STABILITY ANALYSIS
STA. 21+00, DEER CREEK DRAINAGE (PORTAL AREA)

Deer Creek Mine Reclamation Project
Huntington, Utah

Material Description	Friction Angle (degrees)	Cohesion (psf)
CLAYEY GRAVEL	31	288
CLAY	31	100
BEDROCK	45	1000



SCALE: 1" = 30'

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Figure 6 SLOPE STABILITY ANALYSIS
STA. 0+00, DEER DRAINAGE (PORTAL AREA)

Deer Creek Mine Reclamation Project
Huntington, Utah

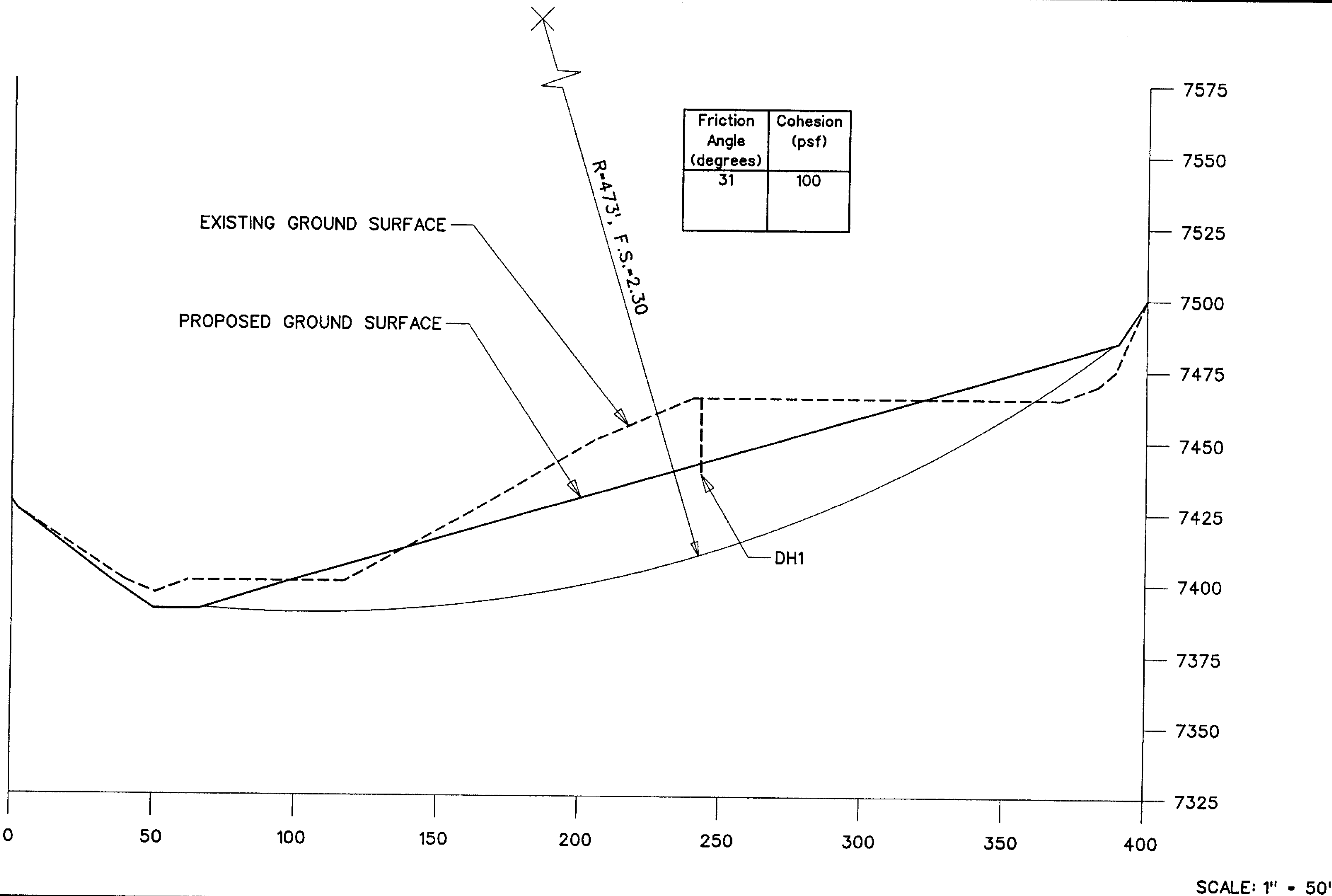

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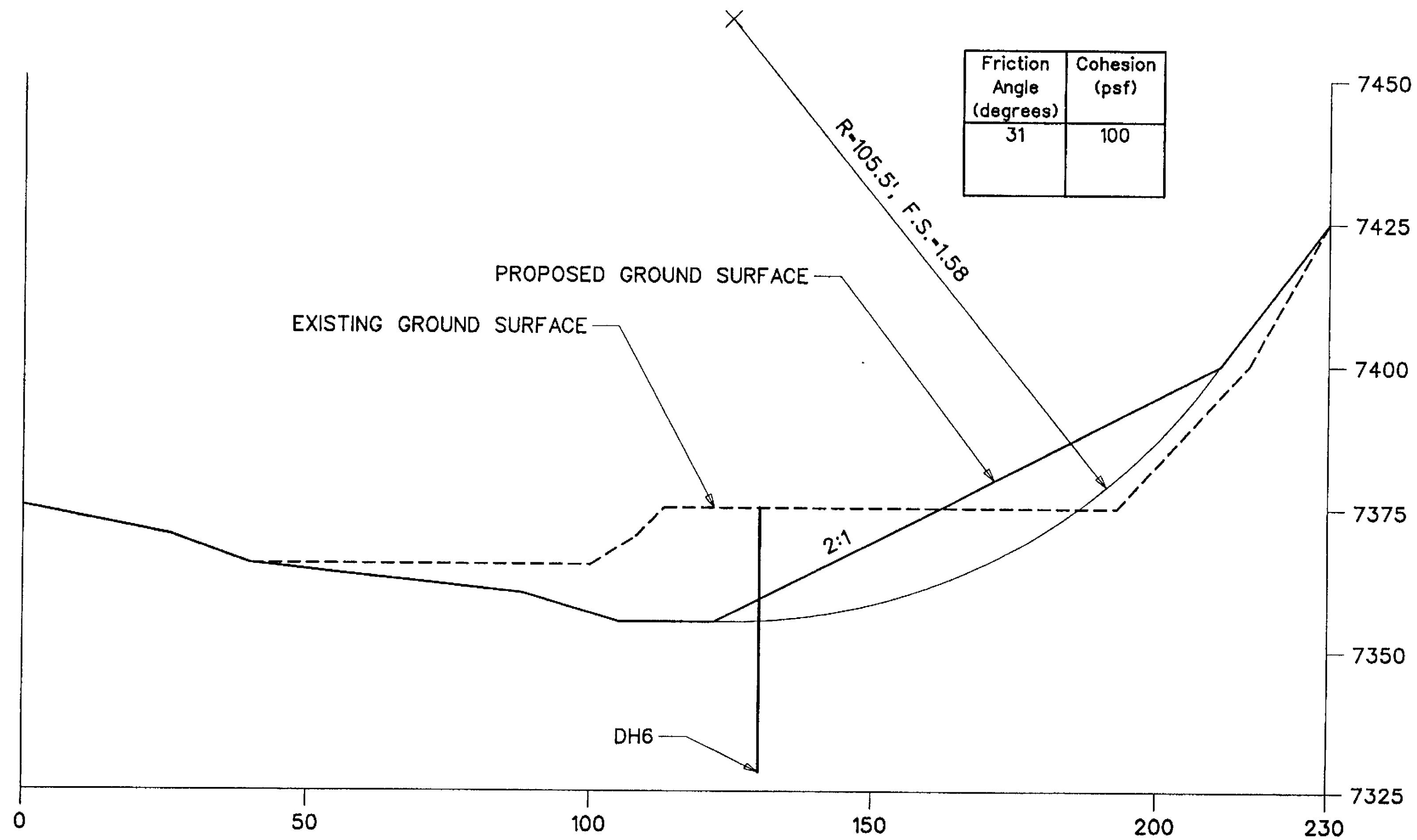
Figure 7 SLOPE STABILITY ANALYSIS - STA. 13+00,
DEER CREEK DRAINAGE (WASTE ROCK STORAGE AREA 1)

Deer Creek Mine Reclamation Project
Huntington, Utah



SCALE: 1" = 30'

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Figure 8 SLOPE STABILITY ANALYSIS - STA. 5+00,
ELK CANYON DRAINAGE (WASTE ROCK STORAGE AREA 2)

Deer Creek Mine Reclamation Project
Huntington, Utah

Material Description	Friction Angle (degrees)	Cohesion (psf)
CONCRETE AND ASPHALT DEBRIS	38	0
CLAYEY GRAVEL	31	100

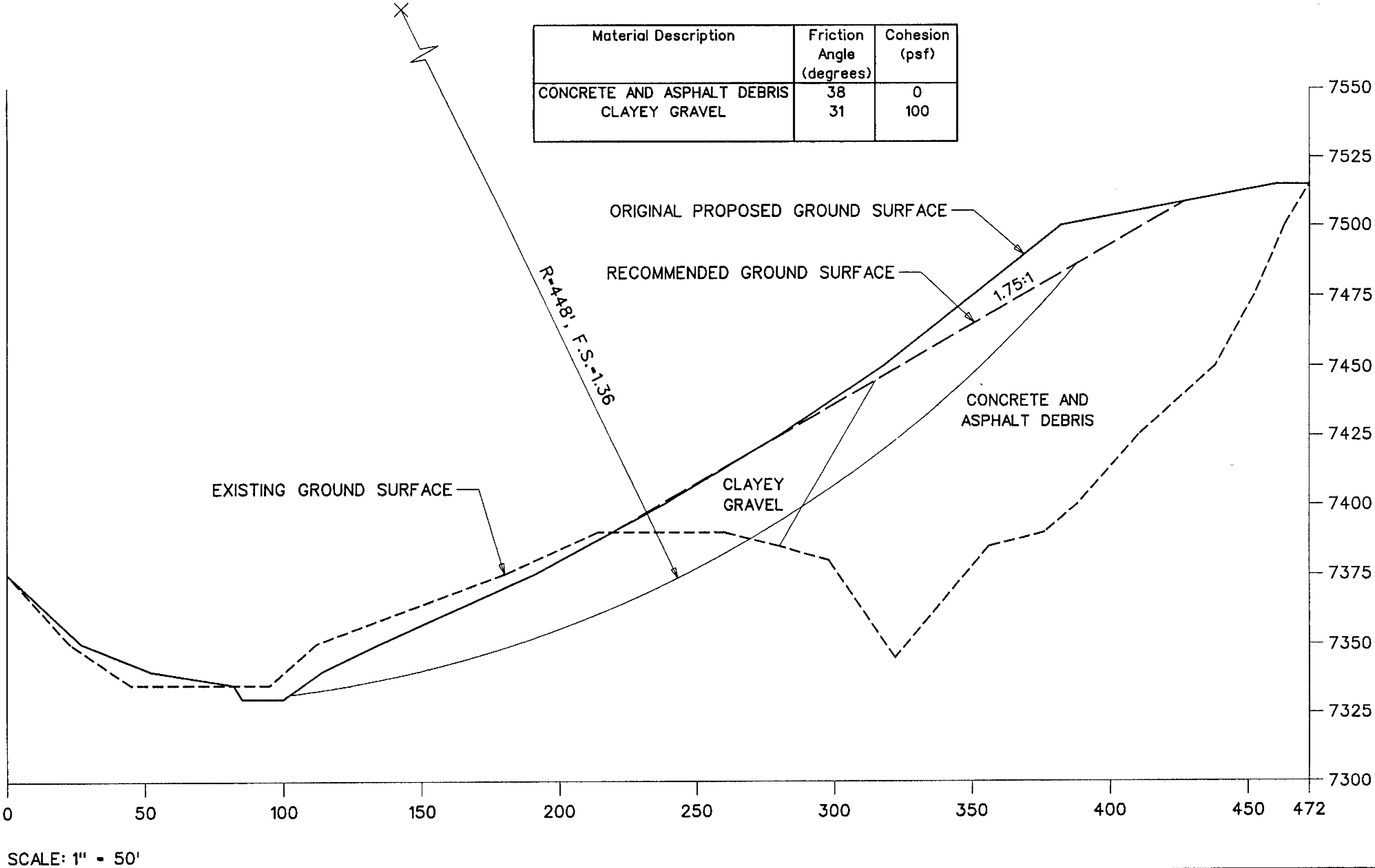

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Figure 9 SLOPE STABILITY ANALYSIS
STA. 2+00, ELK CANYON DRAINAGE (COAL BIN)

Deer Creek Mine Reclamation Project
Huntington, Utah

Test Hole Logs

DRILL HOLE LOG

PROJECT: DEER CREEK MINE RECLAMATION PROJECT
PROJECT NO.: 200001.035
CLIENT: ENERGY WEST MINING COMPANY
DATE: 4/17/00
LOCATION: SEE SITE PLAN
ELEVATION: -
DRILLER: B. HARTLEY
LOGGED BY: M. HANSEN/V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.W. CASING
DEPTH TO WATER - INITIAL: NONE AFTER 24 HOURS: -

BORING NO. 1
STA. 14+00 FILL
Sheet: 1 of 1

Elev. (Feet)	Depth (Feet)	Lithology	Sample Type	Rec. (In.)	Blows Per 6"	USCS	Material Description		Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
				11	32,56/5.5"	GP	brown	SANDY GRAVEL								
								COAL DUST W/COAL GRAVEL								
				15	35,46,39	SC,GC	dry to moist	INTERBEDDED BLACK AND BROWN CUT SANDSTONE COBBLES W/DK. BROWN CLAYEY MATRIX coal dust		5.8			39	42	19	
	5															
				11	7,7,9	CL-1,GC	black and brown	GRAVELLY LEAN CLAY W/SAND TO CLAYEY GRAVEL W/WOOD		13.4	30	11				
	10			14	8,8,38 0.57	GC,CL-1	dk. brown 2" sandstone			11.1	22	7	34	33	33	
				15	9,24,29	GC	dk. brown	GRAVEL, SANDSTONE AND COBBLES W/SANDY CLAY MATRIX some coal dust		8.3			49	31	20	
	15			8	11,10,13	GP-GC	dk. brown moist	GRAVEL W/SANDY LEAN CLAY MATRIX AND SANDSTONE ROCK FRAGMENTS								
	20			7	13,6,5	GP	gray									
	25			8	17,17,9	GP	brown									
	30															

LEGEND

2,3,2 — Blow Count per 6"
0.45 — Torvane (tsf)
Disturbed Sample
Undisturbed Sample
Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

DRILL HOLE LOG

BORING NO. 2
STA. 28+00 FAN
Sheet: 1 of 1

PROJECT: DEER CREEK MINE RECLAMATION PROJECT
PROJECT NO.: 200001.035
CLIENT: ENERGY WEST MINING COMPANY
DATE: 4/17/00
LOCATION: SEE SITE PLAN
ELEVATION: -
DRILLER: B. HARTLEY
LOGGED BY: M. HANSEN/V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.W. CASING
DEPTH TO WATER - INITIAL: NONE AFTER 24 HOURS: -

Elev. (Feet)	Depth (Feet)	Lithology	Sample Type	Rec. (In.)	Blows Per 6"	USCS	Material Description		Dry Density, pcf	Moisture Content, %	Liquid Limit, %	Plasticity Index, %	Gravel, %	Sand, %	Silt/Clay, %	Other Tests
	0–2.2			18	9,13,19	SP-SC	dk. brown moist	CLAYEY SAND W/SANDSTONE GRAVEL								
	2.2–5			0	47/0.5"		yellow	SANDSTONE BOULDER								
	5–7.7			6	14,9,12	SM/GP	lt. brown	SAND AND CUT SANDSTONE								
	7.7–10						lt. brown	SANDSTONE BOULDER								
	10–11.5			18	33,14,19	SP-SM/GP	lt. brown	SILTY SAND W/SANDSTONE GRAVEL								

Depth scale: 5, 10, 15, 20

RB&G ENGINEERING INC.
Provo, Utah

LEGEND

- 2,3,2 — Blow Count per 6"
- 0.45 — Torvane (tsf)
- Disturbed Sample
- Undisturbed Sample
- Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test

DRILL HOLE LOG

BORING NO. 2A
STA. 27+25
Sheet: 1 of 1

PROJECT: DEER CREEK MINE RECLAMATION PROJECT
PROJECT NO.: 200001.035
CLIENT: ENERGY WEST MINING COMPANY
DATE: 4/25/00
LOCATION: SEE SITE PLAN
ELEVATION: -
DRILLER: B. HARTLEY
LOGGED BY: M. HANSEN/V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.W. CASING
DEPTH TO WATER - INITIAL: NONE AFTER 24 HOURS: -

Elev. (Feet)	Depth (Feet)	Rec. (In.)	Blows Per 6"	USCS	Material Description		Dry Density, pcf	Moisture Content, %	Liquid Limit, %	Plasticity Index, %	Gravel, %	Sand, %	Silt/Clay, %	Other Tests
		17	8,8,8	CL	brown moist	CLAY W/GRAVEL AND SAND								
		14	16,22,19	GP-GC	brown to dk. brown moist	GRAVEL W/SAND AND CLAY								
	5													
		14	9,9,13 0.30	CL	dk. brown moist, wood	SANDY LEAN CLAY W/GRAVEL								
	10	13	12,16,56/4" 0.67	SC,GC	w/silty sand looks like compacted fill			11.2			28	39	33	
						BOULDER								
		13	16,19,26	GC	brown some travertine gravel	GRAVEL W/SANDY LEAN CLAY MATRIX								
	15					BOULDER								
		16	17,64,17	SC,GC	brown	CLAYEY SAND W/GRAVEL		7.6			31	46	23	
						SANDSTONE COBBLE								
	20	16	15,16,15	GP	lt. brown dry to moist	GRAVEL W/SAND								
	25					SANDSTONE								
		8	38,26,29	SM	lt. yellow-brown	SILTY SAND W/GRAVEL AND SANDSTONE COBBLES		12.4			33	54	13	
	30	8	48,47											
	35													
	40													

LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

DRILL HOLE LOG

BORING NO. 3
STA. 22+00
BELT PORTAL
Sheet: 1 of 1

PROJECT: DEER CREEK MINE RECLAMATION PROJECT	PROJECT NO.: 200001.035
CLIENT: ENERGY WEST MINING COMPANY	DATE: 4/17/00
LOCATION: SEE SITE PLAN	ELEVATION: -
DRILLER: B. HARTLEY	LOGGED BY: M. HANSEN/V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.W. CASING	
DEPTH TO WATER - INITIAL: NONE	AFTER 24 HOURS: -

Elev. (Feet)	Depth (Feet)	Rec. (In.)	Blows Per 6"	USCS		Material Description	Dry Density, pcf	Moisture Content, %	Liquid Limit, %	Plasticity Index, %	Gravel, %	Sand, %	Silt/Clay, %	Other Tests
		18	19,12,13	CL	dk. brown	SANDY CLAY								
						CONCRETE (POOR)								
						WOOD								
				CL	dk. brown	SANDY LEAN CLAY W/GRAVEL								
		10	7,9,13 0.70	CL-1	2" wood	(fill)		16.4	26	10				
	5													
		16	2,3,2 0.30	CL	dk. brown moist, w/some coal dust	SANDY LEAN CLAY W/GRAVEL								
			Pushed	CL										
	10	11	2,2,1 0.30	SC	moist, w/fine gravel	LEAN CLAYEY SAND W/GRAVEL AND COAL DUST		14.4	21	6	21	42	37	
		10	Pushed	CL-ML	red-brown wet	SILTY CLAY W/SAND AND GRAVEL	100.7	20.7	22	5				DS
		13	14,5,7	SC	red-brown	CLAYEY SAND W/SANDSTONE GRAVEL								
	15					5" SANDSTONE								
		11	14,5,3	GM		SILTY GRAVEL W/SAND sandstone gravel		13.5	18	3	39	33	28	
					boulder									
	20	12	12,11,12	GP-GM	yellow-brown	SANDY GRAVEL W/SILT								
	25	11	13,56/5.5"	SM	yellow-brown	SILTY FINE SAND sandstone								
	30													

RB&G ENGINEERING INC.
Provo, Utah

LEGEND

- 2,3,2 ← Blow Count per 6"
- 0.45 ← Torvane (tsf)
- Disturbed Sample
- Undisturbed Sample
- Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test
DS - Direct Shear Test

DRILL HOLE LOG

BORING NO. 4
STA. 21+00 PORTAL
Sheet: 1 of 1

PROJECT: DEER CREEK MINE RECLAMATION PROJECT
PROJECT NO.: 200001.035
CLIENT: ENERGY WEST MINING COMPANY
DATE: 4/18/00
LOCATION: SEE SITE PLAN
ELEVATION: -
DRILLER: B. HARTLEY
LOGGED BY: M. HANSEN/V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.W. CASING
DEPTH TO WATER - INITIAL: 11.40' AFTER 24 HOURS: -

Elev. (Feet)	Depth (Feet)	Rec. (In.)	Blows Per 6"	USCS	Color	Material Description	Dry Density, pcf	Moisture Content, %	Liquid Limit, %	Plasticity Index, %	Gravel, %	Sand, %	Silt/Clay, %	Other Tests
		16	9,10,14	GC	dk. brown	CLAYEY GRAVEL W/SAND								
						1" WOOD								
						CLAY W/COAL AND GRAVEL								
						3" SANDSTONE								
		8	26,28,18	GC	brown	LEAN CLAYEY GRAVEL W/SAND		14.7			36	34	30	
	5													
		1	7,7,8			CLAYEY GRAVEL								
	10	8	10,16,22	GC	brown; boulder			11.3			50	21	29	
		11	6,6,7	SC	black	COAL W/SANDY CLAY MATRIX								
	15	8	Pushed	CL-1	dk. brown to black	CLAY W/COAL LENSES	98.3	18.1	31	13				DS
	20	14	13,36,64	CL	dk. brown and black	INTERBEDDED CLAY W/COAL FLAKES, SHALE AND WEATHERED SHALE								
	25					SHALE AND SANDSTONE BEDROCK								
	30	60	Core 100,88		lt. gray	SILTSTONE AND MUDSTONE W/COAL LENSES								
	35													
	40													

LEGEND

- 2,3,2 — Blow Count per 6"
- 0.45 — Torvane (tsf)
- Disturbed Sample
- Core 100,60 — Rock Quality Designation (RQD)
- Percent Sample Recovery
- Undisturbed Sample
- Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test
DS - Direct Shear Test

RB&G ENGINEERING INC.
Provo, Utah

DRILL HOLE LOG

BORING NO. 5
STA. 0+00
PORTAL ENTRANCE
Sheet: 1 of 1

PROJECT: DEER CREEK MINE RECLAMATION PROJECT
PROJECT NO.: 200001.035
CLIENT: ENERGY WEST MINING COMPANY
DATE: 4/18/00
LOCATION: SEE SITE PLAN
ELEVATION: -
DRILLER: B. HARTLEY
LOGGED BY: M. HANSEN/V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.W. AND N.Q. CASING
DEPTH TO WATER - INITIAL: 1.00' AFTER 24 HOURS: -

Elev. (Feet)	Depth (Feet)	Lithology	Sample Type	Rec. (In.)	Blows Per 6"	USCS	Material Description		Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
				15	3,2,9	CL	very dk. brown and black	COAL AND CLAY W/SANDSTONE GRAVEL								
				14	12,14,18	CL										
	5							BEDROCK								
				38	Core 97,69		very lt. gray very fractured	SILTSTONE/MUDSTONE W/LEAF FOSSILS								
	10			37	Core 95,23		black	CARONACEOUS MUDSTONE								
				19	Core 90,42											
	15			58	Core 97,80		very lt. gray	SILTY MUDSTONE								
							very lt. gray	2" CLAYEY MUDSTONE								
	20															

LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Core
100,60 ← Rock Quality Designation (RQD)
Percent Sample Recovery
Undisturbed Sample
Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

DRILL HOLE LOG

PROJECT: DEER CREEK MINE RECLAMATION PROJECT
PROJECT NO.: 200001.035
CLIENT: ENERGY WEST MINING COMPANY
DATE: 4/25/00
LOCATION: SEE SITE PLAN
ELEVATION: -
DRILLER: B. HARTLEY
LOGGED BY: M. HANSEN/V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.W. CASING
DEPTH TO WATER - INITIAL: ~42.50' (Caved In) AFTER 24 HOURS: -

BORING NO. 6

et: 1 of 1

Elev. (Feet)	Depth (Feet)	Rec. (In.)	Blows Per 6"	USCS	Material Description		Dry Density, pcf	Moisture Content, %	Liquid Limit, %	Plasticity Index, %	Gravel, %	Sand, %	Silt/Clay, %	Other Tests
	0–3	18	18,29,24		black moist	COAL AND COAL DUST W/SOME SANDSTONE GRAVEL								
	3–11.5	18	9,11,11	GC	red-brown and black moist	LEAN CLAYEY GRAVEL W/SAND, COAL AND WOOD		9.6			38	32	30	
		6	17,14,9		2" red burnt rock sandstone 4" coal and dust									
		12	5,5,6		dry, 2" large gravel siltstone 10" coal w/1" shale yellow and amber lenses									
	11.5–19	13	6,7,8	GC	moist	INTERBEDDED COAL, WEATHERED SHALE AND SANDY CLAY W/ROUNDED GRAVEL		11.2			41	43	16	
		2	Pushed		crushed end of shelby									
		15	34,20,26											
	19–24	15	24,21,17	GC		INTERBEDDED SANDY CLAY, SILTSTONE AND COAL 2" to 3" layers		7.3			48	38	14	
	24–28	16	21,18,20		black	COAL W/CLAY LAYERS								
	28–35	11	19,27,43	ML	dk. brown moist, some coal flakes softer drilling below 32'	SILT W/GRAVEL AND SAND		11.1			25	22	53	
	35–39	18	6,8,17	SM	boulder	SILTY SAND SIZED COAL								
	39–44	7	3,3,4	SM	3" brown 4" dk. brown drills like cobbles and boulders	SILTY SAND W/WOOD								
	44–46.5	7	18,9,11	CL	gray-brown wet, angular	SANDY CLAY W/GRAVEL								

LEGEND

2,3,2 — Blow Count per 6"
0.45 — Torvane (tsf)
Disturbed Sample
Undisturbed Sample
Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

DRILL HOLE LOG

BORING NO. 7

Sheet: 1 of 1

PROJECT: DEER CREEK MINE RECLAMATION PROJECT
PROJECT NO.: 200001.035
CLIENT: ENERGY WEST MINING COMPANY
DATE: 4/26/00
LOCATION: SEE SITE PLAN
ELEVATION: -
DRILLER: B. HARTLEY
LOGGED BY: M. HANSEN/V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.W. CASING
DEPTH TO WATER - INITIAL: 7.00' AFTER 24 HOURS: -

Elev. (Feet)	Depth (Feet)	Lithology	Sample Type	Rec. (In.)	Blows Per 6"	USCS	Material Description		Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
				17	9,13,23	CL	dk. brown moist	GRAVELLY CLAY W/COAL DUST								
				17	14,15,16	GC	dk. brown moist	CLAYEY GRAVEL W/SAND (gray mudstone and yellow-brown sandstone)								
	5															
				7	10,10,10	GC	lt. brown moist	SANDSTONE GRAVEL W/SANDY CLAY								
	10			12	7,7,4	CL/SC	dk. brown	SANDY CLAY TO CLAYEY SAND								
				12	6,6,56/5"	GC	dk. gray shale	3" CLAYEY GRAVEL W/SAND 3" SHALE 6" COAL								
	15			3	56/5"	CL	dk. gray	GRAVELLY CLAY W/SAND								
				0	47/6"	SM	3" of sluff, coal and siltstone									
	20															

LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

Unified Soil Classification System

Major Divisions			Group Symbols		Typical Names
COARSE-GRAINED SOILS *more than half of material is* ***larger*** *than No. 200 sieve*	**Gravels** *more than half of coarse fraction is* ***larger*** *than No. 4 sieve size*	**Clean Gravels** *little or no fines*	GW		Well graded gravels, gravel-sand mixtures, little or no fines
			GP		Poorly graded gravels, gravel-sand mixtures, little or no fines
		Gravels With Fines *appreciable amount of fines*	GM*	d	Silty gravels, poorly graded gravel-sand-clay mixtures
				u	
			GC		Clayey gravels, poorly graded gravel-sand-clay mixtures
	Sands *more than half of coarse fraction is* ***smaller*** *than No. 4 sieve size*	**Clean Sands** *little or no fines*	SW		Well graded sands, gravelly sands, little or no fines
			SP		Poorly graded sands, gravelly sands, little or no fines
		Sands with Fines *appreciable amount of fines*	SM*	d	Silty sands, poorly graded sand-silt mixtures
				u	
			SC		Clayey sands, poorly graded sand-clay mixtures
FINE-GRAINED SOILS *more than half of material is* ***smaller*** *than No. 200 sieve*	**Silts and Clays** *liquid limit is* ***less*** *than 50*		ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
			CL	1	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
				2	
			OL		Organic silts and organic silt-clays of low plasticity
	Silts and Clays *liquid limit is* ***greater*** *than 50*		MH		Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
			CH		Inorganic clays of high plasticity, fat clays
			OH		Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS			Pt		Peat and other highly organic soils

Laboratory Classification Criteria

For laboratory classification of coarse-grained soils

Determine percentage of gravel and sand from grain-size curve.

Depending on percentage of fines (*fraction smaller than No. 200 sieve size*), coarse-grained soils are classified as follows:

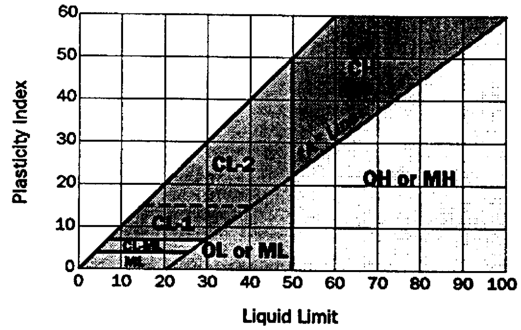
Less than 5% GW, GP, SW, SP

More than 12% GM, GC, SM, SC

5% to 12% Borderline cases requiring use of dual symbols**

Group	Criteria	
GW	$C_u = \frac{D_{60}}{D_{10}}$ Greater than 4 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line, or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring uses of dual symbols
GC	Atterberg limits above "A" line, or PI	
SW	$C_u = \frac{D_{60}}{D_{10}}$ Greater than 6 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
SP	Not meeting all gradation requirements for SW	
SM	Atterberg limits below "A" line, or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring uses of dual symbols
SC	Atterberg limits above "A" line, or PI	

For laboratory classification of fine-grained soils



Plasticity Chart

NOTE: USCS Modified to include CL-type subcategories

*Division of GM and SM groups into subdivisions of d and u for roads and airfields only. Subdivision is based on Atterberg limits; suffix d used when liquid limit is 28 or less and the PI is 6 or less, the suffix u used when liquid limit is greater than 28.

***Borderline classification:* Soils possessing characteristics of two groups are designated by combinations of group symbols. (For example GW-GC, well graded gravel-sand mixture with clay biner.)

Laboratory Testing

Table 1

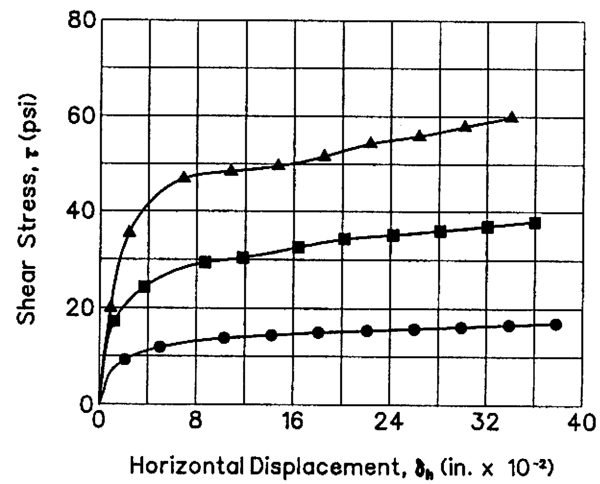
SUMMARY OF TEST DATA

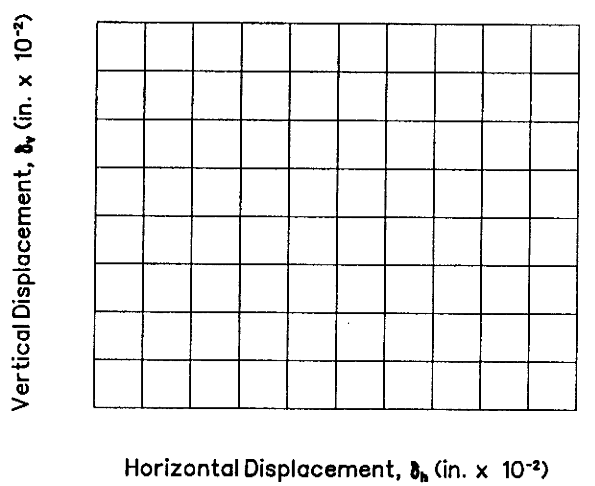
PROJECT Deer Creek Mine Reclamation Project PROJECT NO. 200001-035

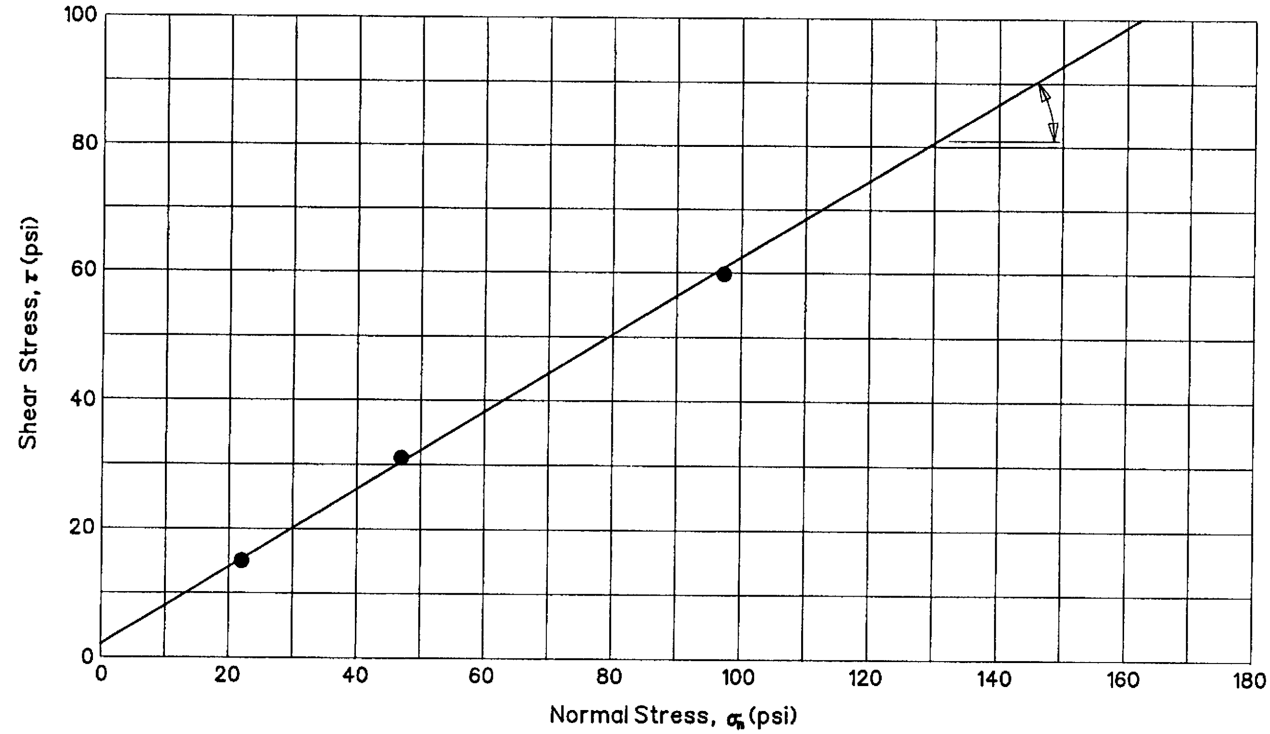
LOCATION Huntington, Utah FEATURE Foundations

HOLE NO.	DEPTH BELOW GROUND SURFACE (ft)	STANDARD PENETRATION BLOWS PER FOOT	IN-PLACE		UNCONFINED COMPRESSIVE STRENGTH (psf)	ATTERBERG LIMITS			MECHANICAL ANALYSIS			UNIFIED SOIL CLASSIFICATION SYSTEM (modified)
			DRY UNIT WEIGHT (pcf)	MOISTURE (%)		LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT & CLAY	
1	3-4.5	85		5.8					39	42	19	SC,GC
	6-7.5	16		13.4		30	19	11				CL-1
	9-10.5	46		11.1		22	15	7	34	33	33	GC,CL-1
	12-13.5	53		8.3					49	31	20	GC
2A	9-10.5	16/6" 56/4"		11.2					28	39	33	SC,GC
	15-16.5	81		7.6					31	46	23	SC,GC
	26.5-28	55		12.4					33	54	13	SM
3	3-4.5	22		16.4		26	16	10				CL-1
	9-10.5	3		14.4		21	15	6	21	42	37	SC
	12-13		100.7	20.7		22	17	5				CL-ML
	15-16.5	8		13.5		18	15	3	39	33	28	GM
4	3-4.5	46		14.7					36	34	30	GC
	9-10.5	38		11.3					50	21	29	GC
	15-16.5		98.3	18.1		31	18	13				CL-1
6	3-4.5	22		9.6					38	32	30	GC
	12-13.5	15		11.2					41	43	16	GC
	20-21.5	38		7.3					48	38	14	GC
	30-31.5	70		11.1				NP	25	22	53	ML

NP=Nonplastic







SAMPLES REMOLDED
NATURAL IN-PLACE UNIT WEIGHT 100.7 PCF @ 20.7% MOISTURE

Test No. or Symbol	Sample Size (inches)	Sample Data		Degree of Saturation (%)	Normal Stress δ_n (psi)	Maximum Shear Stress τ (psi)	Strain Rate (inches/ minute)	Shear Strength Parameters	
		Dry Density (pcf)	Moisture Content (%)					Friction Angle φ (degrees)	Cohesion (c/psi)
●	2.375	99.4	11.7	~100	22.0	15.0	.001	31.2	2
■	2.375	99.4	11.8	~100	44.6	34.3	.001		
▲	2.375	99.2	11.6	~100	97.2	59.8	.001		

RB&G ENGINEERING INC.
Provo, Utah

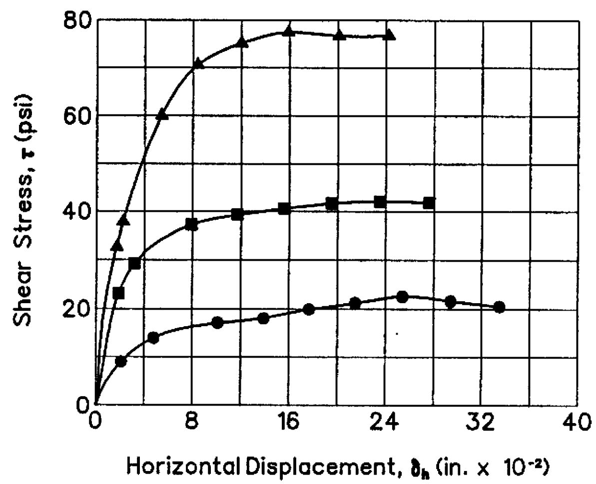
DIRECT SHEAR TEST

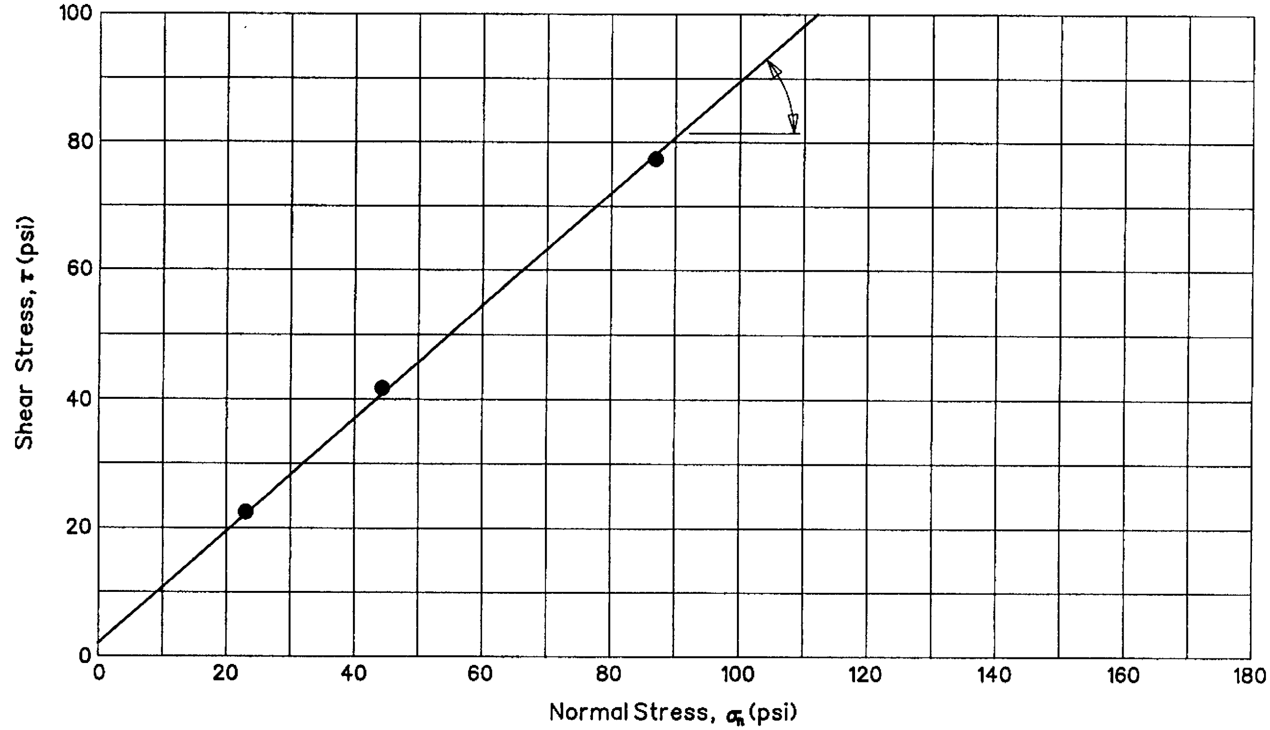
Project: DEER CREEK MINE RECLAMATION PROJECT
HUNTINGTON UTAH

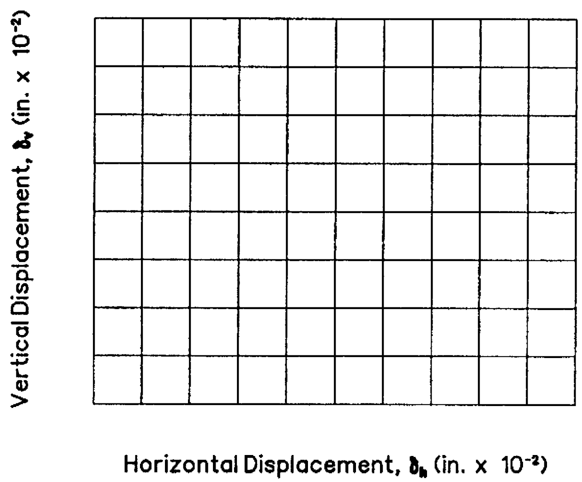
HOLE NO.: 3

DEPTH: 12'-13'

Figure







TESTS ON NATURAL IN-PLACE MATERIAL

Test No. or Symbol	Sample Size (inches)	Sample Data		Degree of Saturation (%)	Normal Stress δ_n (psi)	Maximum Shear Stress τ (psi)	Strain Rate (inches/ minute)	Shear Strength Parameters	
		Dry Density (pcf)	Moisture Content (%)					Friction Angle φ (degrees)	Cohesion (c/psi)
●	2.375	98.3	18.1	~100	23.0	22.5	.001	41.3	2
■	2.375	98.2	18.2	~100	44.3	41.7	.001		
▲	2.375	98.2	18.0	~100	86.9	77.4	.001		

RB&G ENGINEERING INC.
Provo, Utah

Project: DIRECT SHEAR TEST
DEER CREEK MINE RECLAMATION PROJECT
HUNTINGTON, UTAH

HOLE NO.: 4
DEPTH: 15'-16.5'

Figure

Appendix

```
UTEXAS2 - VER. 1.209 -  1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run:  7: 3:2000     Time of this run: 11:21:24
TABLE NO. 1
******************************************
* COMPUTER PROGRAM DESIGNATION - UTEXAS2 *
* Originally Coded By Stephen G. Wright  *
* Version No. 1.209                      *
* Last Revision Date  1/ 7/87            *
* Serial No. 00012                       *
* (C) Copyright 1985 Stephen G. Wright   *
* All Rights Reserved                    *
******************************************

**************************************************************
*                                                            *
*      RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER *
* PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
* HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL   *
* DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE   *
* ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER  *
* PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS      *
* PROGRAM BEFORE ATTEMPTING ITS USE.                         *
*                                                            *
*      NEITHER THE UNIVERSITY OF TEXAS NOR STEPHEN G. WRIGHT *
* MAKE OR ASSUME LIABILITY FOR ANY WARRANTIES, EXPRESSED OR  *
* IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS  *
* OR ADAPTABILITY OF THIS COMPUTER PROGRAM.                  *
*                                                            *
**************************************************************


UTEXAS2 - VER. 1.209 -  1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run:  7: 3:2000     Time of this run: 11:21:24
Sta. 28+00, Deer Creek Drainage (Mine Fan Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO.  2
*************************
* NEW PROFILE LINE DATA *
*************************

PROFILE LINE  1 - MATERIAL TYPE =  1
Sandy Clay w/ Gravel

     Point       X             Y

       1       -20.000       580.000
       2         5.000       580.000
       3        32.000       590.000
       4       102.000       595.000
       5       120.000       600.000
       6       190.000       625.000
       7       265.000       650.000
       8       310.000       675.000
       9       350.000       700.000

All new profile lines defined - No old lines retained


UTEXAS2 - VER. 1.209 -  1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run:  7: 3:2000     Time of this run: 11:21:24
Sta. 28+00, Deer Creek Drainage (Mine Fan Area)
Reclaim Slope Condition
```

```
Circular Shear Surface Search

TABLE NO.  3
******************************
* NEW MATERIAL PROPERTY DATA *
******************************

DATA FOR MATERIAL TYPE  1
Sandy Clay w/ Gravel

     Unit weight of material =  121.500

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -     288.000
     Friction angle - - - - -  31.000 degrees

     No (or zero) pore water pressures

All new material properties defined - No old data retained


UTEXAS2 - VER. 1.209 -  1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run:  7: 3:2000     Time of this run: 11:21:24
Sta. 28+00, Deer Creek Drainage (Mine Fan Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO.  9
*********************************
* NEW ANALYSIS/COMPUTATION DATA *
*********************************

Circular Shear Surface(s)

Automatic Search Performed

Starting Center Coordinate for Search at -
                                             X =     150.000
                                             Y =     725.000

Required accuracy for critical center (= minimum
spacing between grid points) =       1.000

Critical shear surface not allowed to pass below Y =     550.000

For the initial mode of search
all circles are tangent to horizontal line at -
                                             Y =     560.000

Depth of crack =       2.000

Short form of output will be used for search

----------------------------------------------------------------------
THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

Initial trial estimate for the factor of safety =   3.000

Initial trial estimate for side force inclination =  15.000 degrees
(Applicable to Spencer's procedure only)

Maximum number of iterations allowed for
calculating the factor of safety =   40

Allowed force imbalance for convergence =     100.000
```

Allowed moment imbalance for convergence =   100.000

Initial trial values for factor of safety (and side force inclination for Spencer's procedure) will be kept constant during search

Maximum subtended angle to be used for subdivision of the circle into slices =   3.00 degrees

Search will be continued to locate a more critical shear surface (if one exists) after the initial mode is complete

Depth of water in crack =   0.000

Unit weight of water in crack =   62.400

Seismic coefficient = 0.000

Procedure used to compute the factor of safety: SPENCER

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 3:2000   Time of this run: 11:21:24
Sta. 28+00, Deer Creek Drainage (Mine Fan Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 10
****
* NEW SLOPE GEOMETRY DATA *
****

NOTE - NO DATA WERE INPUT, SLOPE GEOMETRY DATA WERE GENERATED BY THE PROGRAM

Slope Coordinates -

Point	X	Y
1	-20.000	580.000
2	5.000	580.000
3	32.000	590.000
4	102.000	595.000
5	120.000	600.000
6	190.000	625.000
7	265.000	650.000
8	310.000	675.000
9	350.000	700.000

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 3:2000   Time of this run: 11:21:24
Sta. 28+00, Deer Creek Drainage (Mine Fan Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 14
****
* SHORT-FORM TABLE FOR SEARCH WITH CIRCULAR SHEAR SURFACES *
****

Mode	Center Coordinates of Critical Circle X	Y	Radius	Factor of Safety	Side Force Inclin.
2 Tangent Line	169.000	747.000	187.000	2.486	16.37

at Y = 560.0

3	Constant Radius of R = 187.0	185.000	788.000	187.000	2.051	20.21
2	Tangent Line at Y = 601.0	185.000	788.000	187.000	2.051	20.21

TABLE NO. 15

***** FINAL CRITICAL CIRCLE INFORMATION *****

X Coordinate of Center - - - - - - - 185.000
Y Coordinate of Center - - - - - - - 788.000
Radius - - - - - - - - - - - - - - - 187.000
Factor of Safety - - - - - - - - - - 2.051
Side Force Inclination - - - - - - - 20.21

Number of circles tried - - - - - - 144
No. of circles F calc. for - - - - - 86

***** CAUTION ***** FACTOR OF SAFETY COULD NOT BE COMPUTED FOR SOME OF GRID POINTS AROUND THE MINIMUM
***** RESULTS MAY BE ERRONEOUS *****

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 3:2000 Time of this run: 11:21:24
Sta. 28+00, Deer Creek Drainage (Mine Fan Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 20

****
* INFORMATION FOR INDIVIDUAL SLICES (INFORMATION IS FOR CRITICAL *
* SHEAR SURFACE IN THE CASE OF AN AUTOMATIC SEARCH) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	138.9	606.8					
1	143.7	605.7	3232.5	1	288.00	31.00	0.0
	148.5	604.6					
2	153.3	603.8	9525.3	1	288.00	31.00	0.0
	158.1	602.9					
3	163.0	602.4	15344.9	1	288.00	31.00	0.0
	167.9	601.8					
4	172.7	601.5	20615.5	1	288.00	31.00	0.0
	177.6	601.1					
5	181.3	601.1	18664.8	1	288.00	31.00	0.0
	185.0	601.0					
6	187.5	601.0	14017.3	1	288.00	31.00	0.0
	190.0	601.1					
7	194.9	601.3	30056.7	1	288.00	31.00	0.0
	199.8	601.6					
8	204.6	602.1	32864.3	1	288.00	31.00	0.0
	209.5	602.6					
9	214.3	603.4	34929.7	1	288.00	31.00	0.0
	219.2	604.2					
10	224.0	605.2	36241.4	1	288.00	31.00	0.0
	228.8	606.2					
11	233.5	607.5	36800.3	1	288.00	31.00	0.0
	238.2	608.7					
12	242.9	610.2	36620.1	1	288.00	31.00	0.0
	247.5	611.8					

13	252.1	613.5	35726.7	1	288.00	31.00	0.0
	256.7	615.3					
14	260.8	617.1	31908.3	1	288.00	31.00	0.0
	265.0	619.0					
15	269.4	621.2	33161.6	1	288.00	31.00	0.0
	273.7	623.4					
16	278.0	625.8	32384.8	1	288.00	31.00	0.0
	282.2	628.3					
17	286.3	630.9	30924.6	1	288.00	31.00	0.0
	290.5	633.6					
18	294.4	636.4	28845.6	1	288.00	31.00	0.0
	298.4	639.3					
19	302.2	642.4	26223.1	1	288.00	31.00	0.0
	306.0	645.4					
20	308.0	647.2	12916.7	1	288.00	31.00	0.0
	310.0	648.9					
21	313.6	652.3	21535.9	1	288.00	31.00	0.0
	317.1	655.6					

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 3:2000 Time of this run: 11:21:24
Sta. 28+00, Deer Creek Drainage (Mine Fan Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 20
****
* INFORMATION FOR INDIVIDUAL SLICES (INFORMATION IS FOR CRITICAL *
* SHEAR SURFACE IN THE CASE OF AN AUTOMATIC SEARCH) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	317.1	655.6					
22	320.5	659.2	18320.2	1	288.00	31.00	0.0
	323.9	662.7					
23	327.0	666.5	14835.1	1	288.00	31.00	0.0
	330.2	670.2					
24	333.2	674.1	11191.3	1	288.00	31.00	0.0
	336.2	677.9					
25	339.0	682.0	7504.7	1	288.00	31.00	0.0
	341.7	686.0					
26	344.3	690.2	3894.6	1	288.00	31.00	0.0
	346.9	694.4					
27	347.6	695.7	512.9	1	288.00	31.00	0.0
	348.3	697.0					

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 3:2000 Time of this run: 11:21:24
Sta. 28+00, Deer Creek Drainage (Mine Fan Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 21
****
* INFORMATION FOR INDIVIDUAL SLICES (INFORMATION IS FOR CRITICAL *
* SHEAR SURFACE IN THE CASE OF AN AUTOMATIC SEARCH) *
****

			FORCES DUE TO SURFACE PRESSURES	
		Y for		
Slice	Seismic	Seismic	Normal	Shear

No.	X	Force	Force	Force	Force	X	Y
1	143.7	0.	607.1	0.	0.	0.0	0.0
2	153.3	0.	607.8	0.	0.	0.0	0.0
3	163.0	0.	608.9	0.	0.	0.0	0.0
4	172.7	0.	610.2	0.	0.	0.0	0.0
5	181.3	0.	611.5	0.	0.	0.0	0.0
6	187.5	0.	612.6	0.	0.	0.0	0.0
7	194.9	0.	614.0	0.	0.	0.0	0.0
8	204.6	0.	616.0	0.	0.	0.0	0.0
9	214.3	0.	618.2	0.	0.	0.0	0.0
10	224.0	0.	620.7	0.	0.	0.0	0.0
11	233.5	0.	623.5	0.	0.	0.0	0.0
12	242.9	0.	626.4	0.	0.	0.0	0.0
13	252.1	0.	629.6	0.	0.	0.0	0.0
14	260.8	0.	632.9	0.	0.	0.0	0.0
15	269.4	0.	636.8	0.	0.	0.0	0.0
16	278.0	0.	641.5	0.	0.	0.0	0.0
17	286.3	0.	646.4	0.	0.	0.0	0.0
18	294.4	0.	651.4	0.	0.	0.0	0.0
19	302.2	0.	656.5	0.	0.	0.0	0.0
20	308.0	0.	660.5	0.	0.	0.0	0.0
21	313.6	0.	664.8	0.	0.	0.0	0.0
22	320.5	0.	670.4	0.	0.	0.0	0.0
23	327.0	0.	676.1	0.	0.	0.0	0.0
24	333.2	0.	681.8	0.	0.	0.0	0.0
25	339.0	0.	687.5	0.	0.	0.0	0.0
26	344.3	0.	693.3	0.	0.	0.0	0.0
27	347.6	0.	697.1	0.	0.	0.0	0.0

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 3:2000 Time of this run: 11:21:24
Sta. 28+00, Deer Creek Drainage (Mine Fan Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 23

```
******************************************************************
* INFORMATION GENERATED DURING ITERATIVE SOLUTION FOR THE FACTOR *
* OF SAFETY AND SIDE FORCE INCLINATION BY SPENCER'S PROCEDURE    *
******************************************************************
```

```
        Trial    Trial
        Factor   Side Force   Force      Moment               Delta
Iter-   of       Inclination  Imbalance  Imbalance   Delta-F  Theta
ation   Safety   (degrees)    (lbs.)     (ft.-lbs.)           (degrees)

  1   3.00000    15.0000  0.7355E+05 -0.4038E+08
First-order corrections to F and THETA ......... -0.147E+01 0.133E+01
Values factored by 0.340E+00 - Deltas too large  -0.500E+00 0.453E+00

  2   2.50000    15.4526  0.4367E+05 -0.2414E+08
First-order corrections to F and THETA ......... -0.596E+00 0.176E+01
Values factored by 0.838E+00 - Deltas too large  -0.500E+00 0.147E+01

  3   2.00000    16.9254 -0.1883E+04  0.3905E+06
First-order corrections to F and THETA .........  0.528E-01 0.362E+01
Second-order correction - Iteration  1 ........  0.545E-01 0.362E+01
Second-order correction - Iteration  2 ........  0.545E-01 0.362E+01

  4   2.05448    20.5427 -0.2105E+01  0.6228E+05
First-order corrections to F and THETA ......... -0.353E-02-0.332E+00
Second-order correction - Iteration  1 ........ -0.352E-02-0.332E+00
Second-order correction - Iteration  2 ........ -0.352E-02-0.332E+00
```

```
   5   2.05097     20.2111  0.3788E-02  0.1155E+03
First-order corrections to F and THETA ......... -0.681E-05-0.638E-03
Second-order correction - Iteration   1 ........ -0.679E-05-0.636E-03

   6   2.05096     20.2105 -0.7778E-02 -0.5258E+01
First-order corrections to F and THETA .........  0.600E-06 0.496E-04

FACTOR OF SAFETY - - - - - - - -       2.051
SIDE FORCE INCLINATION - - - - -       20.21
NUMBER OF ITERATIONS - - - - - -       6
```

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 3:2000 Time of this run: 11:21:24
Sta. 28+00, Deer Creek Drainage (Mine Fan Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 24

```
********************************************
* FINAL RESULTS FOR SHEAR SURFACE (CRITICAL *
* SURFACE IN CASE OF A SEARCH)              *
********************************************
```

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 2.051 Side Force Inclination = 20.21 Degrees

-------- VALUES AT CENTER OF BASE OF SLICE---------

Slice No.	X-center	Y-center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	143.7	605.7	568.5	568.5	307.0
2	153.3	603.8	1365.7	1365.7	540.5
3	163.0	602.4	2023.5	2023.5	733.2
4	172.7	601.5	2558.3	2558.3	889.9
5	181.3	601.1	2940.0	2940.0	1001.8
6	187.5	601.0	3166.8	3166.8	1068.2
7	194.9	601.3	3363.6	3363.6	1125.8
8	204.6	602.1	3547.2	3547.2	1179.6
9	214.3	603.4	3652.1	3652.1	1210.4
10	224.0	605.2	3684.9	3684.9	1220.0
11	233.5	607.5	3651.6	3651.6	1210.2
12	242.9	610.2	3557.7	3557.7	1182.7
13	252.1	613.5	3408.6	3408.6	1139.0
14	260.8	617.1	3217.7	3217.7	1083.1
15	269.4	621.2	3079.1	3079.1	1042.5
16	278.0	625.8	2976.9	2976.9	1012.5
17	286.3	630.9	2821.2	2821.2	966.9
18	294.4	636.4	2617.4	2617.4	907.2
19	302.2	642.4	2371.1	2371.1	835.1
20	308.0	647.2	2160.4	2160.4	773.3
21	313.6	652.3	1942.0	1942.0	709.4
22	320.5	659.2	1650.3	1650.3	623.9
23	327.0	666.5	1332.5	1332.5	530.8
24	333.2	674.1	995.7	995.7	432.1
25	339.0	682.0	647.5	647.5	330.1
26	344.3	690.2	296.2	296.2	227.2
27	347.6	695.7	72.9	72.9	161.8

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = 0.02 (= 0.219E-01)
SHOULD NOT EXCEED 0.100E+03

```
SUM OF FORCES IN HORIZONTAL DIRECTION  =        0.03  (= 0.261E-01)
     SHOULD NOT EXCEED    0.100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN =        4.58  (= 0.458E+01)
     SHOULD NOT EXCEED    0.100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM   =        0.01  (= 0.127E-01)
     SHOULD NOT EXCEED    0.100E+03


UTEXAS2 - VER. 1.209 -  1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run:  7: 3:2000     Time of this run: 11:21:24
Sta. 28+00, Deer Creek Drainage (Mine Fan Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 25
*********************************************
* FINAL RESULTS FOR SHEAR SURFACE (CRITICAL *
* SURFACE IN CASE OF A SEARCH)              *
*********************************************

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety =  2.051     Side Force Inclination =  20.21 Degrees

       --------------- VALUES AT RIGHT SIDE OF SLICE ----------------
```

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	148.5	4433.	607.4	0.509	788.8	704.3
2	158.1	12406.	607.5	0.426	607.7	1572.8
3	167.9	22488.	608.0	0.404	584.5	2173.6
4	177.6	33502.	608.8	0.396	606.0	2629.5
5	185.0	41833.	609.7	0.393	635.4	2899.0
6	190.0	47299.	610.5	0.394	672.6	3045.7
7	199.8	57172.	612.2	0.397	768.6	3254.2
8	209.5	65521.	614.2	0.403	885.3	3371.2
9	219.2	72010.	616.7	0.409	1007.9	3412.2
10	228.8	76444.	619.4	0.417	1135.5	3386.6
11	238.2	78757.	622.5	0.426	1268.0	3302.7
12	247.5	79000.	625.9	0.436	1405.7	3168.9
13	256.7	77329.	629.6	0.447	1548.7	2994.6
14	265.0	74264.	633.2	0.451	1566.9	2856.7
15	273.7	69472.	637.4	0.444	1373.3	2771.4
16	282.2	63188.	641.8	0.432	1119.3	2668.8
17	290.5	55709.	646.5	0.422	910.4	2509.9
18	298.4	47399.	651.4	0.414	736.2	2305.3
19	306.0	38676.	656.6	0.407	587.7	2066.6
20	310.0	33953.	659.4	0.402	500.2	1931.5
21	317.1	25394.	664.9	0.390	339.0	1664.2
22	323.9	17401.	670.6	0.376	199.3	1362.3
23	330.2	10439.	676.5	0.361	94.9	1027.7
24	336.2	4951.	682.6	0.347	27.8	664.6
25	341.7	1340.	689.1	0.347	11.5	273.5
26	346.9	-53.	695.4	0.274	4.8	-31.7
27	348.3	0.	1837.6	ABOVE	1.7	-1.7

```
CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION    =        0.02  (= 0.219E-01)
     SHOULD NOT EXCEED    0.100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION  =        0.03  (= 0.261E-01)
     SHOULD NOT EXCEED    0.100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN =        4.58  (= 0.458E+01)
     SHOULD NOT EXCEED    0.100E+03
```

```
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM    =         0.01  (= 0.127E-01)
     SHOULD NOT EXCEED    0.100E+03

***** CAUTION ***** FORCES BETWEEN SLICES ARE NEGATIVE AT POINTS
                    ALONG THE UPPER ONE-HALF OF THE SHEAR SURFACE -
                    A TENSION CRACK MAY BE NEEDED.


END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED
```

```
UTEXAS2 - VER. 1.209 -  1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run:  7: 3:2000     Time of this run: 11:29: 8
TABLE NO. 1
*****************************************
* COMPUTER PROGRAM DESIGNATION - UTEXAS2 *
* Originally Coded By Stephen G. Wright  *
* Version No. 1.209                      *
* Last Revision Date  1/ 7/87            *
* Serial No. 00012                       *
* (C) Copyright 1985 Stephen G. Wright   *
* All Rights Reserved                    *
*****************************************

***************************************************************
*                                                             *
*      RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER *
* PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
* HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL   *
* DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE   *
* ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER  *
* PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS      *
* PROGRAM BEFORE ATTEMPTING ITS USE.                         *
*                                                             *
*      NEITHER THE UNIVERSITY OF TEXAS NOR STEPHEN G. WRIGHT *
* MAKE OR ASSUME LIABILITY FOR ANY WARRANTIES, EXPRESSED OR  *
* IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS  *
* OR ADAPTABILITY OF THIS COMPUTER PROGRAM.                  *
*                                                             *
***************************************************************


UTEXAS2 - VER. 1.209 -  1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run:  7: 3:2000     Time of this run: 11:29: 8
Sta. 21+00, Deer Creek Drainage (Portal Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO.  2
*************************
* NEW PROFILE LINE DATA *
*************************

PROFILE LINE  1 - MATERIAL TYPE =  1
Sandy Clay w/ Gravel

     Point      X            Y

       1      150.000      467.000
       2      227.000      470.000
       3      237.000      475.000
       4      287.000      500.000
       5      300.000      525.000
       6      340.000      550.000

All new profile lines defined - No old lines retained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Date of this run:  7: 3:2000     Time of this run: 11:29: 8
Sta. 21+00, Deer Creek Drainage (Portal Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO.  3
```

****
* NEW MATERIAL PROPERTY DATA *
****

DATA FOR MATERIAL TYPE 1
Sandy Clay w/ Gravel

Unit weight of material = 121.500

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 288.000
Friction angle - - - - - 31.000 degrees

No (or zero) pore water pressures

All new material properties defined - No old data retained

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 3:2000 Time of this run: 11:29: 8
Sta. 21+00, Deer Creek Drainage (Portal Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 6
****
* NEW SLOPE GEOMETRY DATA *
****

All new data input - No old data retained

Slope Coordinates -

Point	X	Y
1	150.000	467.000
2	227.000	470.000
3	237.000	475.000
4	287.000	500.000

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
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Sta. 21+00, Deer Creek Drainage (Portal Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 9
****
* NEW ANALYSIS/COMPUTATION DATA *
****

Circular Shear Surface(s)

Automatic Search Performed

Starting Center Coordinate for Search at -
X = 225.000
Y = 525.000

Required accuracy for critical center (= minimum
spacing between grid points) = 0.300

Critical shear surface not allowed to pass below Y = 440.000

For the initial mode of search
all circles are tangent to horizontal line at -
Y = 470.000

Depth of crack = 3.000

Short form of output will be used for search

THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

Initial trial estimate for the factor of safety = 3.000

Initial trial estimate for side force inclination = 15.000 degrees
(Applicable to Spencer's procedure only)

Maximum number of iterations allowed for
calculating the factor of safety = 40

Allowed force imbalance for convergence = 100.000

Allowed moment imbalance for convergence = 100.000

Initial trial values for factor of safety (and side force inclination
for Spencer's procedure) will be kept constant during search

Maximum subtended angle to be used for subdivision of the
circle into slices = 3.00 degrees

Search will be continued to locate a more critical shear
surface (if one exists) after the initial mode is complete

Depth of water in crack = 0.000

Unit weight of water in crack = 62.400

Seismic coefficient = 0.000

Procedure used to compute the factor of safety: SPENCER

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Sta. 21+00, Deer Creek Drainage (Portal Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 14
****
* SHORT-FORM TABLE FOR SEARCH WITH CIRCULAR SHEAR SURFACES *
****

Mode	Center Coordinates of Critical Circle X	Center Coordinates of Critical Circle Y	Radius	Factor of Safety	Side Force Inclin.
2 Tangent Line at Y = 470.0	240.000	521.700	51.700	2.314	20.96
3 Constant Radius of R = 51.7	239.400	520.200	51.700	2.289	20.80
2 Tangent Line at Y = 468.5	239.400	520.200	51.700	2.289	20.80

TABLE NO. 15
***** FINAL CRITICAL CIRCLE INFORMATION *****

X Coordinate of Center - - - - - - -	239.400
Y Coordinate of Center - - - - - - -	520.200
Radius - - - - - - - - - - - - - - -	51.700
Factor of Safety - - - - - - - - - -	2.289
Side Force Inclination - - - - - - -	20.80

Number of circles tried - - - - - - 131
No. of circles F calc. for - - - - - 73

***** CAUTION ***** FACTOR OF SAFETY COULD NOT BE COMPUTED FOR SOME
OF GRID POINTS AROUND THE MINIMUM
***** RESULTS MAY BE ERRONEOUS *****

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 3:2000 Time of this run: 11:29: 8
Sta. 21+00, Deer Creek Drainage (Portal Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 20
****
* INFORMATION FOR INDIVIDUAL SLICES (INFORMATION IS FOR CRITICAL *
* SHEAR SURFACE IN THE CASE OF AN AUTOMATIC SEARCH) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	227.0	470.0					
1	228.3	469.7	305.4	1	288.00	31.00	0.0
	229.7	469.4					
2	231.0	469.2	905.1	1	288.00	31.00	0.0
	232.3	469.0					
3	233.7	468.8	1470.7	1	288.00	31.00	0.0
	235.0	468.7					
4	236.0	468.6	1417.7	1	288.00	31.00	0.0
	237.0	468.6					
5	238.2	468.5	2062.2	1	288.00	31.00	0.0
	239.4	468.5					
6	240.8	468.5	2742.1	1	288.00	31.00	0.0
	242.1	468.6					
7	243.5	468.7	3131.1	1	288.00	31.00	0.0
	244.8	468.8					
8	246.1	469.0	3460.4	1	288.00	31.00	0.0
	247.5	469.1					
9	248.8	469.4	3727.0	1	288.00	31.00	0.0
	250.1	469.6					
10	251.5	469.9	3929.0	1	288.00	31.00	0.0
	252.8	470.3					
11	254.1	470.6	4065.5	1	288.00	31.00	0.0
	255.4	471.0					
12	256.7	471.5	4136.6	1	288.00	31.00	0.0
	257.9	471.9					
13	259.2	472.5	4143.4	1	288.00	31.00	0.0
	260.4	473.0					
14	261.6	473.6	4088.1	1	288.00	31.00	0.0
	262.9	474.1					
15	264.1	474.8	3973.8	1	288.00	31.00	0.0
	265.2	475.4					
16	266.4	476.1	3804.6	1	288.00	31.00	0.0
	267.6	476.8					

17	268.7	477.6	3585.5	1	288.00	31.00	0.0
	269.8	478.4					
18	270.9	479.2	3322.2	1	288.00	31.00	0.0
	271.9	480.0					
19	273.0	480.9	3021.4	1	288.00	31.00	0.0
	274.0	481.8					
20	275.0	482.7	2690.1	1	288.00	31.00	0.0
	276.0	483.6					
21	276.9	484.6	2336.2	1	288.00	31.00	0.0
	277.8	485.6					

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Sta. 21+00, Deer Creek Drainage (Portal Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 20

```
*****************************************************************
* INFORMATION FOR INDIVIDUAL SLICES (INFORMATION IS FOR CRITICAL *
* SHEAR SURFACE IN THE CASE OF AN AUTOMATIC SEARCH)             *
*****************************************************************
```

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	277.8	485.6					
22	278.7	486.6	1968.1	1	288.00	31.00	0.0
	279.6	487.7					
23	280.4	488.7	1594.3	1	288.00	31.00	0.0
	281.2	489.8					
24	282.0	490.9	1223.7	1	288.00	31.00	0.0
	282.8	492.0					
25	283.5	493.2	865.5	1	288.00	31.00	0.0
	284.2	494.4					
26	284.6	495.2	415.0	1	288.00	31.00	0.0
	285.1	496.1					

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Date of this run: 7: 3:2000 Time of this run: 11:29: 8
Sta. 21+00, Deer Creek Drainage (Portal Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 21

```
*****************************************************************
* INFORMATION FOR INDIVIDUAL SLICES (INFORMATION IS FOR CRITICAL *
* SHEAR SURFACE IN THE CASE OF AN AUTOMATIC SEARCH)             *
*****************************************************************
```

						FORCES DUE TO SURFACE PRESSURES	
Slice No.	X	Seismic Force	Y for Seismic Force	Normal Force	Shear Force	X	Y
1	228.3	0.	470.2	0.	0.	0.0	0.0
2	231.0	0.	470.6	0.	0.	0.0	0.0
3	233.7	0.	471.1	0.	0.	0.0	0.0
4	236.0	0.	471.6	0.	0.	0.0	0.0
5	238.2	0.	472.1	0.	0.	0.0	0.0
6	240.8	0.	472.7	0.	0.	0.0	0.0
7	243.5	0.	473.5	0.	0.	0.0	0.0
8	246.1	0.	474.3	0.	0.	0.0	0.0

9	248.8	0.	475.1	0.	0.	0.0	0.0
10	251.5	0.	476.1	0.	0.	0.0	0.0
11	254.1	0.	477.1	0.	0.	0.0	0.0
12	256.7	0.	478.2	0.	0.	0.0	0.0
13	259.2	0.	479.3	0.	0.	0.0	0.0
14	261.6	0.	480.4	0.	0.	0.0	0.0
15	264.1	0.	481.7	0.	0.	0.0	0.0
16	266.4	0.	482.9	0.	0.	0.0	0.0
17	268.7	0.	484.2	0.	0.	0.0	0.0
18	270.9	0.	485.6	0.	0.	0.0	0.0
19	273.0	0.	486.9	0.	0.	0.0	0.0
20	275.0	0.	488.3	0.	0.	0.0	0.0
21	276.9	0.	489.8	0.	0.	0.0	0.0
22	278.7	0.	491.2	0.	0.	0.0	0.0
23	280.4	0.	492.7	0.	0.	0.0	0.0
24	282.0	0.	494.2	0.	0.	0.0	0.0
25	283.5	0.	495.7	0.	0.	0.0	0.0
26	284.6	0.	497.0	0.	0.	0.0	0.0

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 3:2000 Time of this run: 11:29: 8
Sta. 21+00, Deer Creek Drainage (Portal Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 23

```
*******************************************************************
* INFORMATION GENERATED DURING ITERATIVE SOLUTION FOR THE FACTOR *
* OF SAFETY AND SIDE FORCE INCLINATION BY SPENCER'S PROCEDURE    *
*******************************************************************

        Trial     Trial
        Factor  Side Force   Force     Moment               Delta
 Iter-    of    Inclination Imbalance  Imbalance   Delta-F   Theta
 ation  Safety   (degrees)   (lbs.)   (ft.-lbs.)            (degrees)

   1   3.00000    15.0000  0.7160E+04 -0.2842E+07
 First-order corrections to F and THETA ......... -0.102E+01 0.639E+00
 Values factored by 0.490E+00 - Deltas too large  -0.500E+00 0.313E+00

   2   2.50000    15.3133  0.2973E+04 -0.1192E+07
 First-order corrections to F and THETA ......... -0.285E+00 0.127E+01
 Second-order correction - Iteration   1 ........ -0.258E+00 0.127E+01
 Second-order correction - Iteration   2 ........ -0.258E+00 0.127E+01

   3   2.24190    16.5861 -0.3352E+02 -0.1199E+05
 First-order corrections to F and THETA .........  0.484E-01 0.448E+01
 Second-order correction - Iteration   1 ........  0.502E-01 0.448E+01
 Second-order correction - Iteration   2 ........  0.502E-01 0.448E+01

   4   2.29210    21.0627 -0.1510E+01  0.2100E+04
 First-order corrections to F and THETA ......... -0.277E-02-0.261E+00
 Second-order correction - Iteration   1 ........ -0.276E-02-0.261E+00
 Second-order correction - Iteration   2 ........ -0.276E-02-0.261E+00

   5   2.28934    20.8018 -0.1602E-02 -0.2461E-01
 First-order corrections to F and THETA .........  0.122E-05 0.980E-04

 FACTOR OF SAFETY - - - - - - - -       2.289
 SIDE FORCE INCLINATION - - - - -       20.80
 NUMBER OF ITERATIONS - - - - - -       5
```

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT

Date of this run: 7: 3:2000 Time of this run: 11:29: 8
Sta. 21+00, Deer Creek Drainage (Portal Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 24

```
*********************************************
* FINAL RESULTS FOR SHEAR SURFACE (CRITICAL *
* SURFACE IN CASE OF A SEARCH)              *
*********************************************
```

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 2.289 Side Force Inclination = 20.80 Degrees

-------- VALUES AT CENTER OF BASE OF SLICE---------

Slice No.	X-center	Y-center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	228.3	469.7	251.3	251.3	191.8
2	231.0	469.2	512.9	512.9	260.4
3	233.7	468.8	734.4	734.4	318.5
4	236.0	468.6	898.4	898.4	361.6
5	238.2	468.5	1027.8	1027.8	395.6
6	240.8	468.5	1153.5	1153.5	428.6
7	243.5	468.7	1260.2	1260.2	456.6
8	246.1	469.0	1341.0	1341.0	477.8
9	248.8	469.4	1397.9	1397.9	492.7
10	251.5	469.9	1432.4	1432.4	501.7
11	254.1	470.6	1446.1	1446.1	505.3
12	256.7	471.5	1440.5	1440.5	503.9
13	259.2	472.5	1416.9	1416.9	497.7
14	261.6	473.6	1376.6	1376.6	487.1
15	264.1	474.8	1321.0	1321.0	472.5
16	266.4	476.1	1251.4	1251.4	454.2
17	268.7	477.6	1169.1	1169.1	432.6
18	270.9	479.2	1075.5	1075.5	408.1
19	273.0	480.9	972.0	972.0	380.9
20	275.0	482.7	860.0	860.0	351.5
21	276.9	484.6	741.3	741.3	320.4
22	278.7	486.6	617.3	617.3	287.8
23	280.4	488.7	490.0	490.0	254.4
24	282.0	490.9	361.3	361.3	220.6
25	283.5	493.2	233.3	233.3	187.0
26	284.6	495.2	125.9	125.9	158.8

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = 0.00 (= 0.246E-02)
SHOULD NOT EXCEED 0.100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = 0.00 (= 0.322E-02)
SHOULD NOT EXCEED 0.100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = 0.55 (= 0.554E+00)
SHOULD NOT EXCEED 0.100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = 0.00 (= 0.133E-02)
SHOULD NOT EXCEED 0.100E+03

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 3:2000 Time of this run: 11:29: 8
Sta. 21+00, Deer Creek Drainage (Portal Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 25

```
*********************************************
* FINAL RESULTS FOR SHEAR SURFACE (CRITICAL *
* SURFACE IN CASE OF A SEARCH)              *
*********************************************
```

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY

Factor of Safety = 2.289 Side Force Inclination = 20.80 Degrees

--------------- VALUES AT RIGHT SIDE OF SLICE ---------------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	229.7	698.	470.2	0.417	171.3	515.2
2	232.3	1684.	470.3	0.369	92.0	764.1
3	235.0	2836.	470.5	0.349	47.9	948.4
4	237.0	3729.	470.7	0.340	22.3	1059.4
5	239.4	4805.	471.1	0.332	-2.9	1169.7
6	242.1	5958.	471.5	0.326	-26.8	1267.1
7	244.8	6990.	472.0	0.321	-47.2	1338.7
8	247.5	7855.	472.7	0.317	-64.6	1386.7
9	250.1	8520.	473.4	0.313	-79.5	1413.0
10	252.8	8964.	474.2	0.310	-92.1	1419.2
11	255.4	9178.	475.1	0.307	-102.6	1406.7
12	257.9	9161.	476.0	0.304	-111.1	1377.0
13	260.4	8922.	477.1	0.301	-117.7	1331.4
14	262.9	8479.	478.2	0.298	-122.4	1271.1
15	265.2	7856.	479.5	0.294	-125.3	1197.6
16	267.6	7085.	480.7	0.291	-126.4	1112.0
17	269.8	6200.	482.1	0.286	-125.6	1015.8
18	271.9	5241.	483.5	0.281	-122.8	910.2
19	274.0	4252.	485.0	0.275	-118.0	796.5
20	276.0	3276.	486.5	0.268	-110.8	676.1
21	277.8	2358.	488.1	0.259	-100.9	550.6
22	279.6	1540.	489.8	0.246	-87.5	421.4
23	281.2	863.	491.5	0.228	-69.5	290.5
24	282.8	363.	493.2	0.203	-45.5	161.6
25	284.2	70.	495.0	0.157	-16.2	47.0
26	285.1	0.	227.6	BELOW	-0.3	0.3

```
CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION     =        0.00  (= 0.246E-02)
     SHOULD NOT EXCEED     0.100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION   =        0.00  (= 0.322E-02)
     SHOULD NOT EXCEED     0.100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN =        0.55  (= 0.554E+00)
     SHOULD NOT EXCEED     0.100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM    =        0.00  (= 0.133E-02)
     SHOULD NOT EXCEED     0.100E+03
```

END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED

```
UTEXAS2 - VER. 1.209 -  1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
 Date of this run:  7: 6:2000     Time of this run:  8:23:31
 TABLE NO. 1
 *******************************************
 * COMPUTER PROGRAM DESIGNATION - UTEXAS2 *
 * Originally Coded By Stephen G. Wright  *
 * Version No. 1.209                      *
 * Last Revision Date  1/ 7/87            *
 * Serial No. 00012                       *
 * (C) Copyright 1985 Stephen G. Wright   *
 * All Rights Reserved                    *
 *******************************************

 ****************************************************************
 *                                                              *
 *      RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER *
 * PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
 * HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL    *
 * DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE    *
 * ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER   *
 * PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS       *
 * PROGRAM BEFORE ATTEMPTING ITS USE.                          *
 *                                                              *
 *      NEITHER THE UNIVERSITY OF TEXAS NOR STEPHEN G. WRIGHT *
 * MAKE OR ASSUME LIABILITY FOR ANY WARRANTIES, EXPRESSED OR   *
 * IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS   *
 * OR ADAPTABILITY OF THIS COMPUTER PROGRAM.                   *
 *                                                              *
 ****************************************************************


UTEXAS2 - VER. 1.209 -  1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run:  7: 6:2000     Time of this run:  8:23:31
Sta. 0+00, Deer Drainage (Portal Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO.  2
*************************
* NEW PROFILE LINE DATA *
*************************

PROFILE LINE  1 - MATERIAL TYPE =  1
Gravel w/ Sandy Clay

     Point       X           Y

       1        0.000      525.000
       2      150.000      525.000

PROFILE LINE  2 - MATERIAL TYPE =  2
Clay w/Coal and Gravel

     Point       X           Y

       1        0.000      470.000
       2      150.000      470.000

PROFILE LINE  3 - MATERIAL TYPE =  3
Bedrock

     Point       X           Y

       1        0.000      465.000
```

```
        2       150.000       465.000

All new profile lines defined - No old lines retained


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Date of this run:  7: 6:2000      Time of this run:  8:23:31
Sta. 0+00, Deer Drainage (Portal Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO.  3
******************************
* NEW MATERIAL PROPERTY DATA *
******************************

DATA FOR MATERIAL TYPE  1
Gravel w/ Sandy Clay

     Unit weight of material =  121.500

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - - -     288.000
     Friction angle - - - - -  31.000 degrees

     No (or zero) pore water pressures

DATA FOR MATERIAL TYPE  2
Clay with Coal and Gravel

     Unit weight of material =  115.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - - -     100.000
     Friction angle - - - - -  31.000 degrees

     No (or zero) pore water pressures

DATA FOR MATERIAL TYPE  3
Bedrock

     Unit weight of material =  140.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - - -    1000.000
     Friction angle - - - - -  45.000 degrees

     No (or zero) pore water pressures

All new material properties defined - No old data retained


UTEXAS2 - VER. 1.209 -  1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run:  7: 6:2000      Time of this run:  8:23:31
Sta. 0+00, Deer Drainage (Portal Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO.  6
***************************
* NEW SLOPE GEOMETRY DATA *
***************************

All new data input - No old data retained
```

Slope Coordinates -

Point	X	Y
1	0.000	525.000
2	42.000	500.000
3	70.000	475.000
4	90.000	470.000
5	150.000	467.000

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 6:2000 Time of this run: 8:23:31
Sta. 0+00, Deer Drainage (Portal Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 9
****
* NEW ANALYSIS/COMPUTATION DATA *
****

Circular Shear Surface(s)

Automatic Search Performed

Starting Center Coordinate for Search at -
X = 75.000
Y = 525.000

Required accuracy for critical center (= minimum
spacing between grid points) = 0.300

Critical shear surface not allowed to pass below Y = 450.000

For the initial mode of search
all circles are tangent to horizontal line at -
Y = 460.000

Depth of crack = 3.000

Short form of output will be used for search

THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

Initial trial estimate for the factor of safety = 3.000

Initial trial estimate for side force inclination = 15.000 degrees
(Applicable to Spencer's procedure only)

Maximum number of iterations allowed for
calculating the factor of safety = 40

Allowed force imbalance for convergence = 100.000

Allowed moment imbalance for convergence = 100.000

Initial trial values for factor of safety (and side force inclination
for Spencer's procedure) will be kept constant during search

Maximum subtended angle to be used for subdivision of the
circle into slices = 3.00 degrees

Search will be continued to locate a more critical shear surface (if one exists) after the initial mode is complete

Depth of water in crack = 0.000

Unit weight of water in crack = 62.400

Seismic coefficient = 0.000

Procedure used to compute the factor of safety: SPENCER

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 6:2000 Time of this run: 8:23:31
Sta. 0+00, Deer Drainage (Portal Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 14

****
* SHORT-FORM TABLE FOR SEARCH WITH CIRCULAR SHEAR SURFACES *
****

Mode		Center Coordinates of Critical Circle X	Y	Radius	Factor of Safety	Side Force Inclin.
2	Tangent Line at Y = 460.0	73.200	533.700	73.700	2.707	-21.32
3	Constant Radius of R = 73.7	75.000	542.100	73.700	1.475	-26.52
2	Tangent Line at Y = 468.4	77.100	549.000	80.600	1.465	-26.69
3	Constant Radius of R = 80.6	77.100	549.300	80.600	1.464	-26.93

TABLE NO. 15

***** FINAL CRITICAL CIRCLE INFORMATION *****

X Coordinate of Center - - - - - - -	77.100
Y Coordinate of Center - - - - - - -	549.300
Radius - - - - - - - - - - - - - - -	80.600
Factor of Safety - - - - - - - - - -	1.464
Side Force Inclination - - - - - - -	-26.93

Number of circles tried - - - - - -	179
No. of circles F calc. for - - - - -	123

***** CAUTION ***** FACTOR OF SAFETY COULD NOT BE COMPUTED FOR SOME
OF GRID POINTS AROUND THE MINIMUM
***** RESULTS MAY BE ERRONEOUS *****

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 6:2000 Time of this run: 8:23:31
Sta. 0+00, Deer Drainage (Portal Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 20

****
* INFORMATION FOR INDIVIDUAL SLICES (INFORMATION IS FOR CRITICAL *
* SHEAR SURFACE IN THE CASE OF AN AUTOMATIC SEARCH) *

****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	1.6	521.0					
1	2.4	519.1	862.4	1	288.00	31.00	0.0
	3.2	517.1					
2	4.1	515.2	1594.2	1	288.00	31.00	0.0
	5.0	513.3					
3	6.0	511.4	2409.8	1	288.00	31.00	0.0
	7.0	509.6					
4	8.1	507.8	3286.4	1	288.00	31.00	0.0
	9.1	506.0					
5	10.3	504.2	4200.9	1	288.00	31.00	0.0
	11.5	502.5					
6	12.8	500.8	5130.2	1	288.00	31.00	0.0
	14.0	499.1					
7	15.4	497.5	6051.5	1	288.00	31.00	0.0
	16.8	495.9					
8	18.2	494.3	6942.7	1	288.00	31.00	0.0
	19.6	492.8					
9	21.2	491.3	7782.4	1	288.00	31.00	0.0
	22.7	489.8					
10	24.3	488.5	8550.4	1	288.00	31.00	0.0
	25.9	487.1					
11	27.5	485.8	9227.7	1	288.00	31.00	0.0
	29.2	484.5					
12	30.9	483.3	9797.2	1	288.00	31.00	0.0
	32.6	482.1					
13	34.4	481.0	10243.4	1	288.00	31.00	0.0
	36.2	479.8					
14	38.1	478.8	10552.8	1	288.00	31.00	0.0
	39.9	477.8					
15	41.0	477.3	5909.2	1	288.00	31.00	0.0
	42.0	476.7					
16	43.9	475.9	10469.3	1	288.00	31.00	0.0
	45.8	475.0					
17	47.8	474.2	9825.7	1	288.00	31.00	0.0
	49.8	473.5					
18	51.8	472.8	8984.3	1	288.00	31.00	0.0
	53.8	472.1					
19	55.8	471.6	7948.3	1	288.00	31.00	0.0
	57.9	471.0					
20	59.9	470.6	6724.0	1	288.00	31.00	0.0
	62.0	470.1					
21	62.3	470.1	1013.0	1	288.00	31.00	0.0
	62.7	470.0					

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 6:2000 Time of this run: 8:23:31
Sta. 0+00, Deer Drainage (Portal Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 20

****
* INFORMATION FOR INDIVIDUAL SLICES (INFORMATION IS FOR CRITICAL *
* SHEAR SURFACE IN THE CASE OF AN AUTOMATIC SEARCH) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure

	62.7	470.0					
22	64.8	469.7	5055.2	2	100.00	31.00	0.0
	66.9	469.4					
23	68.4	469.2	2745.1	2	100.00	31.00	0.0
	70.0	469.0					
24	72.1	468.9	2830.4	2	100.00	31.00	0.0
	74.2	468.8					
25	75.7	468.7	1681.7	2	100.00	31.00	0.0
	77.1	468.7					
26	79.2	468.8	1986.5	2	100.00	31.00	0.0
	81.3	468.8					
27	83.4	469.0	1336.0	2	100.00	31.00	0.0
	85.5	469.1					
28	87.6	469.4	583.4	2	100.00	31.00	0.0
	89.7	469.7					
29	89.9	469.7	10.8	2	100.00	31.00	0.0
	90.0	469.7					
30	90.6	469.8	17.8	2	100.00	31.00	0.0
	91.2	469.9					

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Date of this run: 7: 6:2000 Time of this run: 8:23:31
Sta. 0+00, Deer Drainage (Portal Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 21

```
*******************************************************************
* INFORMATION FOR INDIVIDUAL SLICES (INFORMATION IS FOR CRITICAL *
* SHEAR SURFACE IN THE CASE OF AN AUTOMATIC SEARCH)               *
*******************************************************************
```

				FORCES DUE TO SURFACE PRESSURES			
Slice No.	X	Seismic Force	Y for Seismic Force	Normal Force	Shear Force	X	Y
1	2.4	0.	521.3	0.	0.	0.0	0.0
2	4.1	0.	518.9	0.	0.	0.0	0.0
3	6.0	0.	516.4	0.	0.	0.0	0.0
4	8.1	0.	514.0	0.	0.	0.0	0.0
5	10.3	0.	511.5	0.	0.	0.0	0.0
6	12.8	0.	509.1	0.	0.	0.0	0.0
7	15.4	0.	506.7	0.	0.	0.0	0.0
8	18.2	0.	504.2	0.	0.	0.0	0.0
9	21.2	0.	501.9	0.	0.	0.0	0.0
10	24.3	0.	499.5	0.	0.	0.0	0.0
11	27.5	0.	497.2	0.	0.	0.0	0.0
12	30.9	0.	494.9	0.	0.	0.0	0.0
13	34.4	0.	492.7	0.	0.	0.0	0.0
14	38.1	0.	490.6	0.	0.	0.0	0.0
15	41.0	0.	488.9	0.	0.	0.0	0.0
16	43.9	0.	487.1	0.	0.	0.0	0.0
17	47.8	0.	484.5	0.	0.	0.0	0.0
18	51.8	0.	482.0	0.	0.	0.0	0.0
19	55.8	0.	479.6	0.	0.	0.0	0.0
20	59.9	0.	477.3	0.	0.	0.0	0.0
21	62.3	0.	476.0	0.	0.	0.0	0.0
22	64.8	0.	474.7	0.	0.	0.0	0.0
23	68.4	0.	472.8	0.	0.	0.0	0.0
24	72.1	0.	471.7	0.	0.	0.0	0.0
25	75.7	0.	471.2	0.	0.	0.0	0.0
26	79.2	0.	470.7	0.	0.	0.0	0.0
27	83.4	0.	470.3	0.	0.	0.0	0.0

28	87.6	0.	470.0	0.	0.	0.0	0.0
29	89.9	0.	469.9	0.	0.	0.0	0.0
30	90.6	0.	469.9	0.	0.	0.0	0.0

```
UTEXAS2 - VER. 1.209 -  1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run:  7: 6:2000      Time of this run:  8:23:31
Sta. 0+00, Deer Drainage (Portal Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 23
*****************************************************************
* INFORMATION GENERATED DURING ITERATIVE SOLUTION FOR THE FACTOR *
* OF SAFETY AND SIDE FORCE INCLINATION BY SPENCER'S PROCEDURE    *
*****************************************************************

        Trial    Trial
        Factor  Side Force   Force     Moment                Delta
Iter-    of    Inclination Imbalance  Imbalance   Delta-F    Theta
ation  Safety   (degrees)    (lbs.)   (ft.-lbs.)           (degrees)

   1   3.00000    -15.0000 -0.4271E+05  0.2056E+08
First-order corrections to F and THETA ......... -0.314E+01-0.207E+01
Values factored by 0.159E+00 - Deltas too large  -0.500E+00-0.330E+00

   2   2.50000    -15.3300 -0.3467E+05  0.1670E+08
First-order corrections to F and THETA ......... -0.181E+01-0.244E+01
Values factored by 0.276E+00 - Deltas too large  -0.500E+00-0.674E+00

   3   2.00000    -16.0045 -0.2296E+05  0.1108E+08
First-order corrections to F and THETA ......... -0.784E+00-0.317E+01
Values factored by 0.637E+00 - Deltas too large  -0.500E+00-0.202E+01

   4   1.50000    -18.0237 -0.3985E+04  0.2026E+07
First-order corrections to F and THETA ......... -0.539E-01-0.630E+01
Second-order correction - Iteration   1 ........ -0.501E-01-0.630E+01
Second-order correction - Iteration   2 ........ -0.501E-01-0.630E+01

   5   1.44994    -24.3273  0.6066E+02  0.1796E+05
First-order corrections to F and THETA .........  0.143E-01-0.269E+01
Second-order correction - Iteration   1 ........  0.147E-01-0.269E+01
Second-order correction - Iteration   2 ........  0.147E-01-0.269E+01

   6   1.46468    -27.0196  0.1325E+01 -0.2209E+04
First-order corrections to F and THETA ......... -0.446E-03 0.898E-01
Second-order correction - Iteration   1 ........ -0.445E-03 0.898E-01

   7   1.46424    -26.9298 -0.4059E-02 -0.1041E+01
First-order corrections to F and THETA ......... -0.907E-06 0.159E-03

FACTOR OF SAFETY - - - - - - - -       1.464
SIDE FORCE INCLINATION - - - - -     -26.93
NUMBER OF ITERATIONS - - - - - -       7


UTEXAS2 - VER. 1.209 -  1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run:  7: 6:2000      Time of this run:  8:23:31
Sta. 0+00, Deer Drainage (Portal Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 24
*******************************************
* FINAL RESULTS FOR SHEAR SURFACE (CRITICAL *
```

* SURFACE IN CASE OF A SEARCH)   *
****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.464   Side Force Inclination = -26.93 Degrees

-------- VALUES AT CENTER OF BASE OF SLICE---------

Slice No.	X-center	Y-center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	2.4	519.1	51.8	51.8	218.0
2	4.1	515.2	207.2	207.2	281.7
3	6.0	511.4	375.8	375.8	350.9
4	8.1	507.8	553.8	553.8	423.9
5	10.3	504.2	737.9	737.9	499.5
6	12.8	500.8	924.8	924.8	576.2
7	15.4	497.5	1111.7	1111.7	652.9
8	18.2	494.3	1295.7	1295.7	728.4
9	21.2	491.3	1474.1	1474.1	801.6
10	24.3	488.5	1644.2	1644.2	871.4
11	27.5	485.8	1803.6	1803.6	936.8
12	30.9	483.3	1949.7	1949.7	996.8
13	34.4	481.0	2080.0	2080.0	1050.2
14	38.1	478.8	2192.0	2192.0	1096.2
15	41.0	477.3	2266.8	2266.8	1126.9
16	43.9	475.9	2265.7	2265.7	1126.4
17	47.8	474.2	2193.8	2193.8	1096.9
18	51.8	472.8	2078.9	2078.9	1049.8
19	55.8	471.6	1916.5	1916.5	983.1
20	59.9	470.6	1701.5	1701.5	894.9
21	62.3	470.1	1552.8	1552.8	833.9
22	64.8	469.7	1324.1	1324.1	611.6
23	68.4	469.2	1009.5	1009.5	482.5
24	72.1	468.9	827.8	827.8	408.0
25	75.7	468.7	762.0	762.0	381.0
26	79.2	468.8	661.1	661.1	339.6
27	83.4	469.0	497.2	497.2	272.3
28	87.6	469.4	273.1	273.1	180.3
29	89.9	469.7	128.4	128.4	121.0
30	90.6	469.8	96.4	96.4	107.9

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION   =   0.00 (= 0.472E-02)
    SHOULD NOT EXCEED   0.100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION   =   0.00 (= 0.368E-02)
    SHOULD NOT EXCEED   0.100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN =   0.57 (= 0.571E+00)
    SHOULD NOT EXCEED   0.100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM   =   0.00 (= 0.288E-02)
    SHOULD NOT EXCEED   0.100E+03

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 6:2000   Time of this run: 8:23:31
Sta. 0+00, Deer Drainage (Portal Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 25
****
* FINAL RESULTS FOR SHEAR SURFACE (CRITICAL *
* SURFACE IN CASE OF A SEARCH)   *

****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.464 Side Force Inclination = -26.93 Degrees

--------------- VALUES AT RIGHT SIDE OF SLICE ---------------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	3.2	-159.	518.7	0.260	10.4	-58.1
2	5.0	165.	511.9	BELOW	-50.5	84.3
3	7.0	955.	510.9	0.119	-97.0	248.0
4	9.1	2167.	508.4	0.177	-133.6	417.8
5	11.5	3738.	505.7	0.204	-164.4	589.3
6	14.0	5590.	503.0	0.221	-191.4	759.6
7	16.8	7632.	500.3	0.232	-215.9	926.2
8	19.6	9763.	497.7	0.240	-238.3	1086.2
9	22.7	11877.	495.2	0.245	-258.8	1236.8
10	25.9	13865.	492.7	0.249	-277.1	1374.7
11	29.2	15622.	490.3	0.252	-292.8	1496.7
12	32.6	17046.	488.1	0.255	-305.3	1598.7
13	36.2	18042.	485.9	0.257	-313.5	1676.4
14	39.9	18528.	483.9	0.259	-315.6	1724.5
15	42.0	18553.	482.8	0.263	-303.2	1743.4
16	45.8	18110.	481.0	0.277	-252.7	1750.5
17	49.8	17048.	479.3	0.300	-156.7	1708.9
18	53.8	15423.	477.9	0.331	-10.1	1596.7
19	57.9	13331.	476.6	0.379	219.7	1384.9
20	62.0	10911.	475.7	0.460	613.5	1003.3
21	62.7	10479.	475.5	0.479	709.8	910.2
22	66.9	8577.	474.5	0.605	1476.1	332.6
23	70.0	7259.	473.7	0.702	2147.0	-204.4
24	74.2	5575.	472.7	0.756	2425.9	-512.5
25	77.1	4385.	472.1	0.748	2150.7	-422.8
26	81.3	2696.	471.4	0.758	1823.5	-392.5
27	85.5	1227.	470.8	0.836	1667.5	-561.2
28	89.7	212.	470.2	ABOVE	2794.2	-1802.1
29	90.0	165.	470.1	ABOVE	2508.1	-1587.2
30	91.2	0.	-356.7	BELOW	0.0	0.0

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = 0.00 (= 0.472E-02)
SHOULD NOT EXCEED 0.100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = 0.00 (= 0.368E-02)
SHOULD NOT EXCEED 0.100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = 0.57 (= 0.571E+00)
SHOULD NOT EXCEED 0.100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = 0.00 (= 0.288E-02)
SHOULD NOT EXCEED 0.100E+03

***** CAUTION ***** FORCES BETWEEN SLICES ARE NEGATIVE AT POINTS ALONG THE UPPER ONE-HALF OF THE SHEAR SURFACE - A TENSION CRACK MAY BE NEEDED.

***** CAUTION ***** SOME OF THE FORCES BETWEEN SLICES ACT AT POINTS ABOVE THE SURFACE OF THE SLOPE OR BELOW THE SHEAR SURFACE - EITHER A TENSION CRACK MAY BE NEEDED OR THE SOLUTION MAY NOT BE A VALID SOLUTION.

END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED

```
UTEXAS2 - VER. 1.209 -  1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run:  7: 3:2000     Time of this run: 12:50:25
TABLE NO. 1
*****************************************
* COMPUTER PROGRAM DESIGNATION - UTEXAS2 *
* Originally Coded By Stephen G. Wright  *
* Version No. 1.209                      *
* Last Revision Date  1/ 7/87            *
* Serial No. 00012                       *
* (C) Copyright 1985 Stephen G. Wright   *
* All Rights Reserved                    *
*****************************************

***************************************************************
*                                                             *
*      RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER *
* PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
* HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL   *
* DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE   *
* ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER  *
* PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS      *
* PROGRAM BEFORE ATTEMPTING ITS USE.                         *
*                                                             *
*      NEITHER THE UNIVERSITY OF TEXAS NOR STEPHEN G. WRIGHT *
* MAKE OR ASSUME LIABILITY FOR ANY WARRANTIES, EXPRESSED OR  *
* IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS  *
* OR ADAPTABILITY OF THIS COMPUTER PROGRAM.                  *
*                                                             *
***************************************************************


UTEXAS2 - VER. 1.209 -  1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run:  7: 3:2000     Time of this run: 12:50:25
Sta. 13+00, Deer Creek Drainage (Waste Rock Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO.  2
*************************
* NEW PROFILE LINE DATA *
*************************

PROFILE LINE  1 - MATERIAL TYPE =  1
Gravel w/ Sandy Clay

     Point        X            Y

       1         2.000       425.000
       2        35.000       400.000
       3        50.000       390.000
       4        66.000       390.000
       5        98.000       400.000
       6       183.000       425.000
       7       270.000       450.000
       8       356.000       475.000
       9       390.000       485.000
      10       400.000       500.000

All new profile lines defined - No old lines retained


UTEXAS2 - VER. 1.209 -  1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run:  7: 3:2000     Time of this run: 12:50:25
Sta. 13+00, Deer Creek Drainage (Waste Rock Area)
```

```
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO.  3
******************************
* NEW MATERIAL PROPERTY DATA *
******************************

DATA FOR MATERIAL TYPE  1
Gravel w/ Sandy Clay

     Unit weight of material =  121.500

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -      100.000
     Friction angle - - - - -  31.000 degrees

     No (or zero) pore water pressures

All new material properties defined - No old data retained


UTEXAS2 - VER. 1.209 -  1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run:  7: 3:2000     Time of this run: 12:50:25
Sta. 13+00, Deer Creek Drainage (Waste Rock Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO.  6
***************************
* NEW SLOPE GEOMETRY DATA *
***************************

All new data input - No old data retained

Slope Coordinates -

     Point        X            Y

        1       50.000      390.000
        2       66.000      390.000
        3       98.000      400.000
        4      183.000      425.000
        5      270.000      450.000
        6      356.000      475.000
        7      390.000      485.000


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Date of this run:  7: 3:2000     Time of this run: 12:50:25
Sta. 13+00, Deer Creek Drainage (Waste Rock Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO.  9
*********************************
* NEW ANALYSIS/COMPUTATION DATA *
*********************************

Circular Shear Surface(s)

Automatic Search Performed

Starting Center Coordinate for Search at -
                                             X =      225.000
```

Y = 525.000

Required accuracy for critical center (= minimum
spacing between grid points) = 0.300

Critical shear surface not allowed to pass below Y = 360.000

For the initial mode of search
all circles are tangent to horizontal line at -
Y = 375.000

Depth of crack = 3.000

Short form of output will be used for search

THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

Initial trial estimate for the factor of safety = 3.000

Initial trial estimate for side force inclination = 15.000 degrees
(Applicable to Spencer's procedure only)

Maximum number of iterations allowed for
calculating the factor of safety = 40

Allowed force imbalance for convergence = 100.000

Allowed moment imbalance for convergence = 100.000

Initial trial values for factor of safety (and side force inclination
for Spencer's procedure) will be kept constant during search

Maximum subtended angle to be used for subdivision of the
circle into slices = 3.00 degrees

Search will be continued to locate a more critical shear
surface (if one exists) after the initial mode is complete

Depth of water in crack = 0.000

Unit weight of water in crack = 62.400

Seismic coefficient = 0.000

Procedure used to compute the factor of safety: SPENCER

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 3:2000 Time of this run: 12:50:25
Sta. 13+00, Deer Creek Drainage (Waste Rock Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 14
****
* SHORT-FORM TABLE FOR SEARCH WITH CIRCULAR SHEAR SURFACES *
****

Mode	Center Coordinates of Critical Circle X	Y	Radius	Factor of Safety	Side Force Inclin.
2 Tangent Line at Y = 375.0	147.300	697.500	322.500	2.484	14.71

3	Constant Radius of R = 322.5	102.900	710.400	322.500	2.393	15.25
2	Tangent Line at Y = 387.9	104.400	856.200	468.300	2.341	15.38
3	Constant Radius of R = 468.3	105.000	856.800	468.300	2.339	15.41
2	Tangent Line at Y = 388.5	103.500	861.900	473.400	2.338	15.41
3	Constant Radius of R = 473.4	103.500	861.900	473.400	2.338	15.41

TABLE NO. 15

***** FINAL CRITICAL CIRCLE INFORMATION *****

X Coordinate of Center - - - - - - - 103.500
Y Coordinate of Center - - - - - - - 861.900
Radius - - - - - - - - - - - - - - - - 473.400
Factor of Safety - - - - - - - - - - 2.338
Side Force Inclination - - - - - - - 15.41

Number of circles tried - - - - - - 514
No. of circles F calc. for - - - - - 378

***** CAUTION ***** FACTOR OF SAFETY COULD NOT BE COMPUTED FOR SOME OF GRID POINTS AROUND THE MINIMUM
***** RESULTS MAY BE ERRONEOUS *****

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 3:2000 Time of this run: 12:50:25
Sta. 13+00, Deer Creek Drainage (Waste Rock Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 20

****
* INFORMATION FOR INDIVIDUAL SLICES (INFORMATION IS FOR CRITICAL *
* SHEAR SURFACE IN THE CASE OF AN AUTOMATIC SEARCH) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	65.8	390.0					
1	65.9	390.0	0.1	1	100.00	31.00	0.0
	66.0	390.0					
2	78.4	389.3	13644.2	1	100.00	31.00	0.0
	90.7	388.7					
3	94.4	388.6	9043.2	1	100.00	31.00	0.0
	98.0	388.5					
4	100.7	388.5	8214.7	1	100.00	31.00	0.0
	103.5	388.5					
5	115.9	388.8	49479.0	1	100.00	31.00	0.0
	128.3	389.1					
6	140.6	390.1	67296.6	1	100.00	31.00	0.0
	153.0	391.1					
7	165.3	392.7	80831.7	1	100.00	31.00	0.0
	177.6	394.3					
8	180.3	394.8	19461.9	1	100.00	31.00	0.0
	183.0	395.2					
9	195.2	397.6	91199.3	1	100.00	31.00	0.0

	207.3	400.0					
10	219.3	403.1	94549.4	1	100.00	31.00	0.0
	231.3	406.1					
11	243.2	409.7	93642.6	1	100.00	31.00	0.0
	255.0	413.4					
12	262.5	416.1	57807.2	1	100.00	31.00	0.0
	270.0	418.7					
13	281.5	423.4	83514.0	1	100.00	31.00	0.0
	293.0	428.1					
14	304.2	433.3	72583.8	1	100.00	31.00	0.0
	315.4	438.6					
15	326.3	444.4	58352.1	1	100.00	31.00	0.0
	337.3	450.2					
16	346.6	455.9	37365.6	1	100.00	31.00	0.0
	356.0	461.5					
17	366.3	468.3	24261.9	1	100.00	31.00	0.0
	376.6	475.2					
18	379.9	477.6	3581.9	1	100.00	31.00	0.0
	383.3	480.0					

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 3:2000 Time of this run: 12:50:25
Sta. 13+00, Deer Creek Drainage (Waste Rock Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 21

```
*****************************************************************
* INFORMATION FOR INDIVIDUAL SLICES (INFORMATION IS FOR CRITICAL *
* SHEAR SURFACE IN THE CASE OF AN AUTOMATIC SEARCH)              *
*****************************************************************
```

Slice No.	X	Seismic Force	Y for Seismic Force	FORCES DUE TO SURFACE PRESSURES Normal Force	Shear Force	X	Y
1	65.9	0.	390.0	0.	0.	0.0	0.0
2	78.4	0.	391.6	0.	0.	0.0	0.0
3	94.4	0.	393.7	0.	0.	0.0	0.0
4	100.7	0.	394.7	0.	0.	0.0	0.0
5	115.9	0.	397.0	0.	0.	0.0	0.0
6	140.6	0.	401.3	0.	0.	0.0	0.0
7	165.3	0.	406.2	0.	0.	0.0	0.0
8	180.3	0.	409.5	0.	0.	0.0	0.0
9	195.2	0.	413.1	0.	0.	0.0	0.0
10	219.3	0.	419.2	0.	0.	0.0	0.0
11	243.2	0.	426.0	0.	0.	0.0	0.0
12	262.5	0.	432.0	0.	0.	0.0	0.0
13	281.5	0.	438.4	0.	0.	0.0	0.0
14	304.2	0.	446.6	0.	0.	0.0	0.0
15	326.3	0.	455.4	0.	0.	0.0	0.0
16	346.6	0.	464.1	0.	0.	0.0	0.0
17	366.3	0.	473.2	0.	0.	0.0	0.0
18	379.9	0.	479.8	0.	0.	0.0	0.0

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 3:2000 Time of this run: 12:50:25
Sta. 13+00, Deer Creek Drainage (Waste Rock Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 23

```
*******************************************************************
* INFORMATION GENERATED DURING ITERATIVE SOLUTION FOR THE FACTOR *
* OF SAFETY AND SIDE FORCE INCLINATION BY SPENCER'S PROCEDURE    *
*******************************************************************

         Trial     Trial
         Factor   Side Force    Force      Moment                 Delta
Iter-      of     Inclination  Imbalance  Imbalance   Delta-F     Theta
ation    Safety    (degrees)    (lbs.)    (ft.-lbs.)            (degrees)

   1    3.00000     15.0000  0.5203E+05 -0.1772E+08
First-order corrections to F and THETA ......... -0.853E+00 0.166E+00
Values factored by 0.587E+00 - Deltas too large  -0.500E+00 0.973E-01

   2    2.50000     15.0973  0.1540E+05 -0.5274E+07
First-order corrections to F and THETA ......... -0.174E+00 0.220E+00
Second-order correction - Iteration   1 ........ -0.163E+00 0.220E+00
Second-order correction - Iteration   2 ........ -0.163E+00 0.220E+00

   3    2.33660     15.3176 -0.6822E+02  0.3892E+04
First-order corrections to F and THETA .........  0.111E-02 0.971E-01
Second-order correction - Iteration   1 ........  0.111E-02 0.971E-01

   4    2.33772     15.4147 -0.1648E-02  0.4489E+02
First-order corrections to F and THETA ......... -0.992E-06-0.225E-03

FACTOR OF SAFETY - - - - - - - -      2.338
SIDE FORCE INCLINATION - - - - -      15.41
NUMBER OF ITERATIONS - - - - - -      4


UTEXAS2 - VER. 1.209 -  1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run:  7: 3:2000      Time of this run: 12:50:25
Sta. 13+00, Deer Creek Drainage (Waste Rock Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 24
*********************************************
* FINAL RESULTS FOR SHEAR SURFACE (CRITICAL *
* SURFACE IN CASE OF A SEARCH)              *
*********************************************

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety =  2.338      Side Force Inclination =  15.41 Degrees

       -------- VALUES AT CENTER OF BASE OF SLICE---------
```

Slice No.	X-center	Y-center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	65.9	390.0	18.0	18.0	47.4
2	78.4	389.3	627.6	627.6	204.1
3	94.4	388.6	1371.1	1371.1	395.2
4	100.7	388.5	1625.9	1625.9	460.7
5	115.9	388.8	2128.9	2128.9	590.0
6	140.6	390.1	2813.5	2813.5	765.9
7	165.3	392.7	3298.1	3298.1	890.5
8	180.3	394.8	3521.0	3521.0	947.8
9	195.2	397.6	3629.6	3629.6	975.7
10	219.3	403.1	3700.2	3700.2	993.8
11	243.2	409.7	3614.3	3614.3	971.8
12	262.5	416.1	3446.3	3446.3	928.6
13	281.5	423.4	3170.2	3170.2	857.6

14	304.2	433.3	2736.8	2736.8	746.2
15	326.3	444.4	2190.2	2190.2	605.7
16	346.6	455.9	1587.7	1587.7	450.9
17	366.3	468.3	903.1	903.1	274.9
18	379.9	477.6	394.6	394.6	144.2

```
CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION    =        0.02  (= 0.203E-01)
     SHOULD NOT EXCEED     0.100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION  =        0.01  (= 0.143E-01)
     SHOULD NOT EXCEED     0.100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN =      -47.87  (=-0.479E+02)
     SHOULD NOT EXCEED     0.100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM   =        0.01  (= 0.718E-02)
     SHOULD NOT EXCEED     0.100E+03
```

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 3:2000 Time of this run: 12:50:25
Sta. 13+00, Deer Creek Drainage (Waste Rock Area)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 25

```
*********************************************
* FINAL RESULTS FOR SHEAR SURFACE (CRITICAL *
* SURFACE IN CASE OF A SEARCH)              *
*********************************************
```

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 2.338 Side Force Inclination = 15.41 Degrees

--------------- VALUES AT RIGHT SIDE OF SLICE ---------------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	66.0	8.	390.0	0.014	-7.5	15.3
2	90.7	6104.	392.7	0.450	453.3	845.4
3	98.0	9275.	393.0	0.389	262.6	1300.2
4	103.5	11957.	393.3	0.368	184.1	1573.4
5	128.3	25687.	395.9	0.343	73.7	2433.2
6	153.0	39643.	399.5	0.335	16.1	3031.7
7	177.6	51273.	404.0	0.331	-19.0	3419.6
8	183.0	53357.	405.1	0.331	-20.2	3479.9
9	207.3	59893.	410.6	0.331	-25.7	3638.5
10	231.3	61383.	417.0	0.332	-19.6	3627.5
11	255.0	57825.	424.1	0.332	-9.9	3462.5
12	270.0	53155.	429.2	0.333	-4.3	3281.5
13	293.0	42932.	437.6	0.334	2.5	2890.9
14	315.4	30468.	446.8	0.335	10.3	2375.4
15	337.3	17692.	456.8	0.338	22.2	1744.4
16	356.0	7983.	466.2	0.348	49.1	1086.2
17	376.6	967.	476.8	0.261	-68.8	388.1
18	383.3	0.	-13932.5	BELOW	28.8	-28.8

```
CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION    =        0.02  (= 0.203E-01)
     SHOULD NOT EXCEED     0.100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION  =        0.01  (= 0.143E-01)
     SHOULD NOT EXCEED     0.100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN =      -47.87  (=-0.479E+02)
```

```
     SHOULD NOT EXCEED     0.100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM   =        0.01  (= 0.718E-02)
     SHOULD NOT EXCEED     0.100E+03

END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED
```

```
UTEXAS2 - VER. 1.209 -  1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run:  7: 6:2000     Time of this run:  7: 9: 3
TABLE NO. 1
*****************************************
* COMPUTER PROGRAM DESIGNATION - UTEXAS2 *
* Originally Coded By Stephen G. Wright  *
* Version No. 1.209                      *
* Last Revision Date  1/ 7/87            *
* Serial No. 00012                       *
* (C) Copyright 1985 Stephen G. Wright   *
* All Rights Reserved                    *
*****************************************

***************************************************************
*                                                             *
*      RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER *
* PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
* HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL   *
* DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE   *
* ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER  *
* PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS      *
* PROGRAM BEFORE ATTEMPTING ITS USE.                         *
*                                                             *
*      NEITHER THE UNIVERSITY OF TEXAS NOR STEPHEN G. WRIGHT *
* MAKE OR ASSUME LIABILITY FOR ANY WARRANTIES, EXPRESSED OR  *
* IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS  *
* OR ADAPTABILITY OF THIS COMPUTER PROGRAM.                  *
*                                                             *
***************************************************************


UTEXAS2 - VER. 1.209 -  1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run:  7: 6:2000     Time of this run:  7: 9: 3
Sta. 2+00, Elk Canyon Drainage (Coal Bin)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO.  2
*************************
* NEW PROFILE LINE DATA *
*************************

PROFILE LINE  1 - MATERIAL TYPE =  1
Concrete and Asphalt Debris

     Point       X            Y

       1       220.000      390.000
       2       425.000      507.000
       3       460.000      515.000
       4       700.000      515.000

PROFILE LINE  2 - MATERIAL TYPE =  2
Gravel w/ Sandy Clay

     Point       X            Y

       1         0.000      375.000
       2        27.000      350.000
       3        82.000      335.000
       4        85.000      330.000
       5       100.000      330.000
       6       135.000      350.000
       7       191.000      375.000
```

8	220.000	390.000
9	260.000	390.000
10	298.000	380.000
11	322.000	345.000
12	438.000	450.000
13	472.000	515.000

All new profile lines defined - No old lines retained

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 6:2000 Time of this run: 7: 9: 3
Sta. 2+00, Elk Canyon Drainage (Coal Bin)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 3
****
* NEW MATERIAL PROPERTY DATA *
****

DATA FOR MATERIAL TYPE 2
Gravel w/ Sandy Clay

Unit weight of material = 121.500

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 100.000
Friction angle - - - - - 31.000 degrees

No (or zero) pore water pressures

DATA FOR MATERIAL TYPE 1
Concrete and Asphalt Debris

Unit weight of material = 130.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 0.000
Friction angle - - - - - 38.000 degrees

No (or zero) pore water pressures

All new material properties defined - No old data retained

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 6:2000 Time of this run: 7: 9: 3
Sta. 2+00, Elk Canyon Drainage (Coal Bin)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 6
****
* NEW SLOPE GEOMETRY DATA *
****

All new data input - No old data retained

Slope Coordinates -

Point	X	Y
1	27.000	350.000
2	52.000	340.000

3	82.000	335.000
4	85.000	330.000
5	100.000	330.000
6	135.000	350.000
7	191.000	375.000
8	220.000	390.000
9	425.000	507.000
10	460.000	515.000
11	472.000	515.000

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 6:2000 Time of this run: 7: 9: 3
Sta. 2+00, Elk Canyon Drainage (Coal Bin)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 9
****
* NEW ANALYSIS/COMPUTATION DATA *
****

Circular Shear Surface(s)

Automatic Search Performed

Starting Center Coordinate for Search at -
X = 200.000
Y = 600.000

Required accuracy for critical center (= minimum
spacing between grid points) = 2.000

Critical shear surface not allowed to pass below Y = 300.000

For the initial mode of search
all circles are tangent to horizontal line at -
Y = 320.000

Depth of crack = 3.000

Short form of output will be used for search

THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

Initial trial estimate for the factor of safety = 3.000

Initial trial estimate for side force inclination = 15.000 degrees
(Applicable to Spencer's procedure only)

Maximum number of iterations allowed for
calculating the factor of safety = 40

Allowed force imbalance for convergence = 100.000

Allowed moment imbalance for convergence = 100.000

Initial trial values for factor of safety (and side force inclination
for Spencer's procedure) will be kept constant during search

Maximum subtended angle to be used for subdivision of the
circle into slices = 3.00 degrees

Search will be continued to locate a more critical shear surface (if one exists) after the initial mode is complete

Depth of water in crack = 0.000

Unit weight of water in crack = 62.400

Seismic coefficient = 0.000

Procedure used to compute the factor of safety: SPENCER

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 6:2000 Time of this run: 7: 9: 3
Sta. 2+00, Elk Canyon Drainage (Coal Bin)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 14

```
************************************************************
* SHORT-FORM TABLE FOR SEARCH WITH CIRCULAR SHEAR SURFACES *
************************************************************
```

Mode		Center Coordinates of Critical Circle X	Y	Radius	Factor of Safety	Side Force Inclin.
2	Tangent Line at Y = 320.0	190.000	620.000	300.000	1.544	23.35
3	Constant Radius of R = 300.0	86.000	630.000	300.000	1.387	25.84
2	Tangent Line at Y = 330.0	50.000	774.000	444.000	1.366	26.91
3	Constant Radius of R = 444.0	48.000	772.000	444.000	1.364	26.86
2	Tangent Line at Y = 328.0	46.000	776.000	448.000	1.364	26.88

TABLE NO. 15

```
***** FINAL CRITICAL CIRCLE INFORMATION *****
X Coordinate of Center - - - - - - -     46.000
Y Coordinate of Center - - - - - - -    776.000
Radius - - - - - - - - - - - - - - -    448.000
Factor of Safety - - - - - - - - - -      1.364
Side Force Inclination - - - - - - -      26.88

Number of circles tried  - - - - - -  265
No. of circles F calc. for - - - - -  195
```

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 6:2000 Time of this run: 7: 9: 3
Sta. 2+00, Elk Canyon Drainage (Coal Bin)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 20

```
******************************************************************
* INFORMATION FOR INDIVIDUAL SLICES (INFORMATION IS FOR CRITICAL *
* SHEAR SURFACE IN THE CASE OF AN AUTOMATIC SEARCH)              *
******************************************************************
```

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	102.8	331.6					
1	114.4	333.4	13605.0	2	100.00	31.00	0.0
	126.0	335.2					
2	130.5	336.1	12410.0	2	100.00	31.00	0.0
	135.0	336.9					
3	146.4	339.6	43164.9	2	100.00	31.00	0.0
	157.9	342.2					
4	169.1	345.4	54316.8	2	100.00	31.00	0.0
	180.4	348.6					
5	185.7	350.4	28647.0	2	100.00	31.00	0.0
	191.0	352.1					
6	202.0	356.2	65410.7	2	100.00	31.00	0.0
	213.0	360.3					
7	216.5	361.7	22548.9	2	100.00	31.00	0.0
	220.0	363.2					
8	230.7	368.0	74034.6	2	100.00	31.00	0.0
	241.4	372.8					
9	250.7	377.6	70423.4	2	100.00	31.00	0.0
	260.0	382.4					
10	264.6	385.0	36230.9	2	100.00	31.00	0.0
	269.2	387.6					
11	279.2	393.7	78417.9	1	0.00	38.00	0.0
	289.2	399.8					
12	293.6	402.7	33376.8	1	0.00	38.00	0.0
	298.0	405.6					
13	307.5	412.4	68087.1	1	0.00	38.00	0.0
	317.0	419.3					
14	319.5	421.2	16504.1	1	0.00	38.00	0.0
	322.0	423.1					
15	331.0	430.6	53615.2	1	0.00	38.00	0.0
	340.1	438.0					
16	348.7	446.0	39324.7	1	0.00	38.00	0.0
	357.4	453.9					
17	365.6	462.3	23125.1	1	0.00	38.00	0.0
	373.8	470.6					
18	377.7	474.9	5149.3	1	0.00	38.00	0.0
	381.6	479.2					

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 6:2000 Time of this run: 7: 9: 3
Sta. 2+00, Elk Canyon Drainage (Coal Bin)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 21

```
*******************************************************************
* INFORMATION FOR INDIVIDUAL SLICES (INFORMATION IS FOR CRITICAL  *
* SHEAR SURFACE IN THE CASE OF AN AUTOMATIC SEARCH)               *
*******************************************************************
```

				FORCES DUE TO SURFACE PRESSURES			
Slice No.	X	Seismic Force	Y for Seismic Force	Normal Force	Shear Force	X	Y
1	114.4	0.	335.8	0.	0.	0.0	0.0
2	130.5	0.	341.7	0.	0.	0.0	0.0
3	146.4	0.	347.3	0.	0.	0.0	0.0
4	169.1	0.	355.3	0.	0.	0.0	0.0
5	185.7	0.	361.5	0.	0.	0.0	0.0
6	202.0	0.	368.4	0.	0.	0.0	0.0

7	216.5	0.	375.0	0.	0.	0.0	0.0
8	230.7	0.	382.2	0.	0.	0.0	0.0
9	250.7	0.	392.8	0.	0.	0.0	0.0
10	264.6	0.	400.3	0.	0.	0.0	0.0
11	279.2	0.	408.7	0.	0.	0.0	0.0
12	293.6	0.	417.4	0.	0.	0.0	0.0
13	307.5	0.	426.2	0.	0.	0.0	0.0
14	319.5	0.	434.0	0.	0.	0.0	0.0
15	331.0	0.	442.0	0.	0.	0.0	0.0
16	348.7	0.	454.7	0.	0.	0.0	0.0
17	365.6	0.	467.7	0.	0.	0.0	0.0
18	377.7	0.	477.5	0.	0.	0.0	0.0

UTEXAS2 - VER. 1.209 - 1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run: 7: 6:2000 Time of this run: 7: 9: 3
Sta. 2+00, Elk Canyon Drainage (Coal Bin)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 23

```
*****************************************************************
* INFORMATION GENERATED DURING ITERATIVE SOLUTION FOR THE FACTOR *
* OF SAFETY AND SIDE FORCE INCLINATION BY SPENCER'S PROCEDURE    *
*****************************************************************

        Trial     Trial
        Factor   Side Force    Force     Moment               Delta
Iter-    of     Inclination  Imbalance  Imbalance   Delta-F    Theta
ation  Safety    (degrees)    (lbs.)   (ft.-lbs.)            (degrees)

   1   3.00000    15.0000  0.1863E+06 -0.5891E+08
First-order corrections to F and THETA ......... -0.344E+01 0.118E+01
Values factored by 0.145E+00 - Deltas too large  -0.500E+00 0.172E+00

   2   2.50000    15.1721  0.1542E+06 -0.4883E+08
First-order corrections to F and THETA ......... -0.202E+01 0.143E+01
Values factored by 0.247E+00 - Deltas too large  -0.500E+00 0.353E+00

   3   2.00000    15.5250  0.1073E+06 -0.3419E+08
First-order corrections to F and THETA ......... -0.930E+00 0.196E+01
Values factored by 0.538E+00 - Deltas too large  -0.500E+00 0.105E+01

   4   1.50000    16.5772  0.3212E+05 -0.1099E+08
First-order corrections to F and THETA ......... -0.161E+00 0.439E+01
Second-order correction - Iteration   1 ....... -0.146E+00 0.439E+01
Second-order correction - Iteration   2 ....... -0.146E+00 0.439E+01

   5   1.35406    20.9669 -0.5270E+03 -0.7138E+06
First-order corrections to F and THETA .........  0.988E-02 0.635E+01
Second-order correction - Iteration   1 .......  0.102E-01 0.635E+01
Second-order correction - Iteration   2 .......  0.102E-01 0.635E+01

   6   1.36427    27.3194 -0.1322E+02  0.7017E+05
First-order corrections to F and THETA ......... -0.540E-03-0.438E+00
Second-order correction - Iteration   1 ....... -0.537E-03-0.438E+00

   7   1.36374    26.8814 -0.1038E-01  0.2386E+03
First-order corrections to F and THETA ......... -0.204E-05-0.155E-02
Second-order correction - Iteration   1 ....... -0.204E-05-0.155E-02

   8   1.36373    26.8799 -0.8545E-03 -0.6211E+00
First-order corrections to F and THETA .........  0.106E-07 0.537E-05

FACTOR OF SAFETY - - - - - - - -     1.364
```

```
SIDE FORCE INCLINATION - - - - -     26.88
NUMBER OF ITERATIONS - - - - - -     8


UTEXAS2 - VER. 1.209 -  1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run:  7: 6:2000     Time of this run:  7: 9: 3
Sta. 2+00, Elk Canyon Drainage (Coal Bin)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 24
*********************************************
* FINAL RESULTS FOR SHEAR SURFACE (CRITICAL *
* SURFACE IN CASE OF A SEARCH)              *
*********************************************

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety =  1.364     Side Force Inclination =  26.88 Degrees

       -------- VALUES AT CENTER OF BASE OF SLICE---------
```

Slice No.	X-center	Y-center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	114.4	333.4	663.8	663.8	365.8
2	130.5	336.1	1464.6	1464.6	718.6
3	146.4	339.6	1918.9	1918.9	918.8
4	169.1	345.4	2314.7	2314.7	1093.2
5	185.7	350.4	2498.6	2498.6	1174.2
6	202.0	356.2	2644.6	2644.6	1238.5
7	216.5	361.7	2761.6	2761.6	1290.1
8	230.7	368.0	2877.4	2877.4	1341.1
9	250.7	377.6	2991.0	2991.0	1391.2
10	264.6	385.0	3004.1	3004.1	1396.9
11	279.2	393.7	2862.2	2862.2	1639.8
12	293.6	402.7	2673.9	2673.9	1531.9
13	307.5	412.4	2405.9	2405.9	1378.3
14	319.5	421.2	2157.9	2157.9	1236.3
15	331.0	430.6	1851.6	1851.6	1060.8
16	348.7	446.0	1338.3	1338.3	766.7
17	365.6	462.3	777.8	777.8	445.6
18	377.7	474.9	347.2	347.2	198.9

```
CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION     =        0.02  (= 0.249E-01)
     SHOULD NOT EXCEED    0.100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION  =        0.02  (= 0.160E-01)
     SHOULD NOT EXCEED    0.100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN =       -4.49  (=-0.449E+01)
     SHOULD NOT EXCEED    0.100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM    =        0.01  (= 0.150E-01)
     SHOULD NOT EXCEED    0.100E+03


UTEXAS2 - VER. 1.209 -  1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run:  7: 6:2000     Time of this run:  7: 9: 3
Sta. 2+00, Elk Canyon Drainage (Coal Bin)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 25
*********************************************
* FINAL RESULTS FOR SHEAR SURFACE (CRITICAL *
```

```
* SURFACE IN CASE OF A SEARCH)              *
*********************************************
```

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.364   Side Force Inclination = 26.88 Degrees

--------------- VALUES AT RIGHT SIDE OF SLICE ----------------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	126.0	6839.	339.3	0.423	338.1	924.6
2	135.0	11245.	341.7	0.385	251.9	1371.5
3	157.9	23475.	349.1	0.386	368.7	1955.8
4	180.4	34378.	357.6	0.413	680.7	2154.1
5	191.0	38583.	361.9	0.419	762.0	2195.2
6	213.0	44889.	371.4	0.427	867.1	2202.4
7	220.0	46096.	374.7	0.425	832.8	2199.9
8	241.4	47021.	385.3	0.424	776.0	2081.8
9	260.0	43979.	395.6	0.433	771.2	1808.5
10	269.2	41057.	401.2	0.446	809.9	1589.9
11	289.2	38670.	412.1	0.414	563.3	1756.8
12	298.0	36297.	417.3	0.405	480.1	1758.6
13	317.0	28776.	429.5	0.391	338.6	1628.8
14	322.0	26400.	432.9	0.388	308.8	1567.5
15	340.1	16925.	445.9	0.382	214.7	1258.4
16	357.4	7994.	459.4	0.380	138.6	844.5
17	373.8	1608.	473.0	0.325	-10.1	411.4
18	381.6	0.	811.0	ABOVE	-0.2	0.2

```
CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION     =        0.02  (= 0.249E-01)
     SHOULD NOT EXCEED    0.100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION   =        0.02  (= 0.160E-01)
     SHOULD NOT EXCEED    0.100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN =       -4.49  (=-0.449E+01)
     SHOULD NOT EXCEED    0.100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM    =        0.01  (= 0.150E-01)
     SHOULD NOT EXCEED    0.100E+03
```

END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED

```
UTEXAS2 - VER. 1.209 -  1/ 7/87 - SN00012 - (C) 1985 S. G. WRIGHT
Date of this run:  7: 4:2000     Time of this run: 10:36:21
TABLE NO. 1
******************************************
* COMPUTER PROGRAM DESIGNATION - UTEXAS2 *
* Originally Coded By Stephen G. Wright  *
* Version No. 1.209                      *
* Last Revision Date  1/ 7/87            *
* Serial No. 00012                       *
* (C) Copyright 1985 Stephen G. Wright   *
* All Rights Reserved                    *
******************************************

**************************************************************
*                                                            *
*      RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER *
* PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
* HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL   *
* DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE   *
* ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER  *
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* PROGRAM BEFORE ATTEMPTING ITS USE.                         *
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**************************************************************


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Sta. 5+00, Elk Canyon Drainage (Waste Rock Storage Area 2)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO.  2
*************************
* NEW PROFILE LINE DATA *
*************************

PROFILE LINE  1 - MATERIAL TYPE =  1
Gravel w/ Sandy Clay

     Point       X            Y

       1        40.000       365.000
       2        88.000       360.000
       3       105.000       355.000
       4       122.000       355.000
       5       162.000       375.000
       6       211.000       400.000
       7       230.000       425.000

All new profile lines defined - No old lines retained


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```

TABLE NO. 3
****
* NEW MATERIAL PROPERTY DATA *
****

DATA FOR MATERIAL TYPE 1
Gravel w/ Sandy Clay

Unit weight of material = 121.500

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 100.000
Friction angle - - - - - 31.000 degrees

No (or zero) pore water pressures

All new material properties defined - No old data retained

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TABLE NO. 6
****
* NEW SLOPE GEOMETRY DATA *
****

All new data input - No old data retained

Slope Coordinates -

Point	X	Y
1	40.000	365.000
2	88.000	360.000
3	105.000	355.000
4	122.000	355.000
5	162.000	375.000
6	211.000	400.000

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TABLE NO. 9
****
* NEW ANALYSIS/COMPUTATION DATA *
****

Circular Shear Surface(s)

Automatic Search Performed

Starting Center Coordinate for Search at -
X = 125.000
Y = 425.000

Required accuracy for critical center (= minimum
spacing between grid points) = 0.500

Critical shear surface not allowed to pass below Y = 330.000

For the initial mode of search
all circles are tangent to horizontal line at -
Y = 350.000

Depth of crack = 3.000

Short form of output will be used for search

THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

Initial trial estimate for the factor of safety = 3.000

Initial trial estimate for side force inclination = 15.000 degrees
(Applicable to Spencer's procedure only)

Maximum number of iterations allowed for
calculating the factor of safety = 40

Allowed force imbalance for convergence = 100.000

Allowed moment imbalance for convergence = 100.000

Initial trial values for factor of safety (and side force inclination
for Spencer's procedure) will be kept constant during search

Maximum subtended angle to be used for subdivision of the
circle into slices = 3.00 degrees

Search will be continued to locate a more critical shear
surface (if one exists) after the initial mode is complete

Depth of water in crack = 0.000

Unit weight of water in crack = 62.400

Seismic coefficient = 0.000

Procedure used to compute the factor of safety: SPENCER

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TABLE NO. 14
****
* SHORT-FORM TABLE FOR SEARCH WITH CIRCULAR SHEAR SURFACES *
****

Mode		Center Coordinates of Critical Circle X	Y	Radius	Factor of Safety	Side Force Inclin.
2	Tangent Line at Y = 350.0	135.500	432.000	82.000	1.750	21.11
3	Constant Radius of R = 82.0	140.500	442.000	82.000	1.629	23.52
2	Tangent Line	135.500	451.000	91.000	1.611	23.81

at Y = 360.0

3	Constant Radius of R = 91.0	133.000	448.000	91.000	1.607	23.70
2	Tangent Line at Y = 357.0	129.000	455.000	98.000	1.595	23.90
3	Constant Radius of R = 98.0	128.500	453.000	98.000	1.591	23.80
2	Tangent Line at Y = 355.0	124.500	460.500	105.500	1.580	23.99
3	Constant Radius of R = 105.5	124.500	460.500	105.500	1.580	23.99

TABLE NO. 15
***** FINAL CRITICAL CIRCLE INFORMATION *****
X Coordinate of Center - - - - - - - 124.500
Y Coordinate of Center - - - - - - - 460.500
Radius - - - - - - - - - - - - - - - 105.500
Factor of Safety - - - - - - - - - - 1.580
Side Force Inclination - - - - - - - 23.99

Number of circles tried - - - - - - 391
No. of circles F calc. for - - - - - 215

***** CAUTION ***** FACTOR OF SAFETY COULD NOT BE COMPUTED FOR SOME
OF GRID POINTS AROUND THE MINIMUM
***** RESULTS MAY BE ERRONEOUS *****

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Circular Shear Surface Search

TABLE NO. 20
****
* INFORMATION FOR INDIVIDUAL SLICES (INFORMATION IS FOR CRITICAL *
* SHEAR SURFACE IN THE CASE OF AN AUTOMATIC SEARCH) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	122.1	355.0					
1	123.3	355.0	185.5	1	100.00	31.00	0.0
	124.5	355.0					
2	127.3	355.1	1716.1	1	100.00	31.00	0.0
	130.0	355.1					
3	132.8	355.4	3362.5	1	100.00	31.00	0.0
	135.5	355.6					
4	138.3	355.9	4786.8	1	100.00	31.00	0.0
	141.0	356.3					
5	143.7	356.8	5976.5	1	100.00	31.00	0.0
	146.4	357.3					
6	149.1	358.0	6923.4	1	100.00	31.00	0.0
	151.8	358.6					
7	154.5	359.4	7623.3	1	100.00	31.00	0.0
	157.1	360.2					
8	159.6	361.0	7587.9	1	100.00	31.00	0.0

	162.0	361.9					
9	164.6	362.9	8297.0	1	100.00	31.00	0.0
	167.1	364.0					
10	169.6	365.2	8317.8	1	100.00	31.00	0.0
	172.1	366.3					
11	174.5	367.7	8113.9	1	100.00	31.00	0.0
	177.0	369.0					
12	179.3	370.4	7700.9	1	100.00	31.00	0.0
	181.7	371.8					
13	184.0	373.4	7098.5	1	100.00	31.00	0.0
	186.2	375.0					
14	188.4	376.6	6329.7	1	100.00	31.00	0.0
	190.6	378.3					
15	192.7	380.1	5420.4	1	100.00	31.00	0.0
	194.8	381.9					
16	196.9	383.8	4399.6	1	100.00	31.00	0.0
	198.9	385.7					
17	200.8	387.7	3298.7	1	100.00	31.00	0.0
	202.7	389.7					
18	204.5	391.8	2151.0	1	100.00	31.00	0.0
	206.3	393.9					
19	206.8	394.5	412.5	1	100.00	31.00	0.0
	207.3	395.1					

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Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 21

```
******************************************************************
* INFORMATION FOR INDIVIDUAL SLICES (INFORMATION IS FOR CRITICAL *
* SHEAR SURFACE IN THE CASE OF AN AUTOMATIC SEARCH)              *
******************************************************************
```

Slice No.	X	Seismic Force	Y for Seismic Force	FORCES DUE TO SURFACE PRESSURES Normal Force	Shear Force	X	Y
1	123.3	0.	355.3	0.	0.	0.0	0.0
2	127.3	0.	356.4	0.	0.	0.0	0.0
3	132.8	0.	357.9	0.	0.	0.0	0.0
4	138.3	0.	359.5	0.	0.	0.0	0.0
5	143.7	0.	361.3	0.	0.	0.0	0.0
6	149.1	0.	363.3	0.	0.	0.0	0.0
7	154.5	0.	365.3	0.	0.	0.0	0.0
8	159.6	0.	367.4	0.	0.	0.0	0.0
9	164.6	0.	369.6	0.	0.	0.0	0.0
10	169.6	0.	372.0	0.	0.	0.0	0.0
11	174.5	0.	374.5	0.	0.	0.0	0.0
12	179.3	0.	377.1	0.	0.	0.0	0.0
13	184.0	0.	379.8	0.	0.	0.0	0.0
14	188.4	0.	382.6	0.	0.	0.0	0.0
15	192.7	0.	385.4	0.	0.	0.0	0.0
16	196.9	0.	388.3	0.	0.	0.0	0.0
17	200.8	0.	391.2	0.	0.	0.0	0.0
18	204.5	0.	394.2	0.	0.	0.0	0.0
19	206.8	0.	396.2	0.	0.	0.0	0.0

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```
Sta. 5+00, Elk Canyon Drainage (Waste Rock Storage Area 2)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 23
*****************************************************************
* INFORMATION GENERATED DURING ITERATIVE SOLUTION FOR THE FACTOR *
* OF SAFETY AND SIDE FORCE INCLINATION BY SPENCER'S PROCEDURE    *
*****************************************************************

        Trial     Trial
        Factor   Side Force    Force      Moment              Delta
Iter-     of    Inclination  Imbalance  Imbalance   Delta-F    Theta
ation   Safety   (degrees)     (lbs.)   (ft.-lbs.)           (degrees)

   1   3.00000    15.0000  0.2064E+05 -0.6502E+07
First-order corrections to F and THETA ......... -0.273E+01 0.748E+00
Values factored by 0.183E+00 - Deltas too large  -0.500E+00 0.137E+00

   2   2.50000    15.1372  0.1613E+05 -0.5087E+07
First-order corrections to F and THETA ......... -0.150E+01 0.937E+00
Values factored by 0.334E+00 - Deltas too large  -0.500E+00 0.313E+00

   3   2.00000    15.4500  0.9471E+04 -0.3003E+07
First-order corrections to F and THETA ......... -0.570E+00 0.146E+01
Values factored by 0.877E+00 - Deltas too large  -0.500E+00 0.128E+01

   4   1.50000    16.7277 -0.1471E+04  0.3812E+06
First-order corrections to F and THETA .........  0.182E+00 0.374E+02
Values factored by 0.230E+00 - Deltas too large   0.418E-01 0.859E+01

   5   1.54182    25.3221 -0.1205E+04  0.3261E+06
First-order corrections to F and THETA .........  0.251E-01-0.403E+01
Second-order correction - Iteration   1 .......  0.278E-01-0.403E+01
Second-order correction - Iteration   2 .......  0.278E-01-0.403E+01

   6   1.56965    21.2958  0.8431E+01 -0.2706E+05
First-order corrections to F and THETA .........  0.976E-02 0.273E+01
Second-order correction - Iteration   1 .......  0.999E-02 0.273E+01
Second-order correction - Iteration   2 .......  0.999E-02 0.273E+01

   7   1.57964    24.0288 -0.4184E+00  0.4497E+03
First-order corrections to F and THETA ......... -0.125E-03-0.362E-01
Second-order correction - Iteration   1 ....... -0.125E-03-0.362E-01

   8   1.57951    23.9926  0.3586E-03 -0.3410E+00
First-order corrections to F and THETA .........  0.884E-07 0.263E-04

FACTOR OF SAFETY - - - - - - - -     1.580
SIDE FORCE INCLINATION - - - - -     23.99
NUMBER OF ITERATIONS - - - - - -     8


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Sta. 5+00, Elk Canyon Drainage (Waste Rock Storage Area 2)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 24
********************************************
* FINAL RESULTS FOR SHEAR SURFACE (CRITICAL *
* SURFACE IN CASE OF A SEARCH)              *
********************************************
```

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.580 Side Force Inclination = 23.99 Degrees

-------- VALUES AT CENTER OF BASE OF SLICE---------

Slice No.	X-center	Y-center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	123.3	355.0	127.7	127.7	111.9
2	127.3	355.1	395.8	395.8	213.9
3	132.8	355.4	707.7	707.7	332.5
4	138.3	355.9	951.7	951.7	425.3
5	143.7	356.8	1135.5	1135.5	495.2
6	149.1	358.0	1265.5	1265.5	544.7
7	154.5	359.4	1347.5	1347.5	575.9
8	159.6	361.0	1386.3	1386.3	590.7
9	164.6	362.9	1390.2	1390.2	592.2
10	169.6	365.2	1362.7	1362.7	581.7
11	174.5	367.7	1303.6	1303.6	559.2
12	179.3	370.4	1216.6	1216.6	526.1
13	184.0	373.4	1105.3	1105.3	483.8
14	188.4	376.6	973.2	973.2	433.5
15	192.7	380.1	823.9	823.9	376.7
16	196.9	383.8	660.8	660.8	314.7
17	200.8	387.7	487.7	487.7	248.8
18	204.5	391.8	308.2	308.2	180.5
19	206.8	394.5	193.0	193.0	136.7

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = 0.00 (= 0.242E-02)
SHOULD NOT EXCEED 0.100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = 0.00 (= 0.293E-02)
SHOULD NOT EXCEED 0.100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = 0.63 (= 0.632E+00)
SHOULD NOT EXCEED 0.100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = 0.00 (= 0.142E-02)
SHOULD NOT EXCEED 0.100E+03

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Sta. 5+00, Elk Canyon Drainage (Waste Rock Storage Area 2)
Reclaim Slope Condition
Circular Shear Surface Search

TABLE NO. 25
****
* FINAL RESULTS FOR SHEAR SURFACE (CRITICAL *
* SURFACE IN CASE OF A SEARCH) *
****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.580 Side Force Inclination = 23.99 Degrees

--------------- VALUES AT RIGHT SIDE OF SLICE ----------------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	124.5	303.	355.6	0.446	150.2	292.9
2	130.0	1533.	356.6	0.387	116.2	608.3
3	135.5	3202.	357.8	0.357	66.9	878.8

4	141.0	5000.	359.1	0.344	35.4	1078.3
5	146.4	6693.	360.6	0.337	13.4	1220.4
6	151.8	8109.	362.4	0.333	-2.7	1313.1
7	157.1	9134.	364.2	0.330	-14.8	1362.2
8	162.0	9682.	366.2	0.327	-24.9	1372.9
9	167.1	9801.	368.4	0.324	-35.7	1350.7
10	172.1	9457.	370.8	0.321	-45.3	1297.1
11	177.0	8694.	373.3	0.318	-52.9	1215.4
12	181.7	7588.	376.0	0.315	-58.8	1109.0
13	186.2	6236.	378.8	0.310	-63.1	980.9
14	190.6	4753.	381.7	0.305	-66.1	834.1
15	194.8	3266.	384.8	0.296	-67.4	671.4
16	198.9	1909.	388.0	0.282	-66.4	494.9
17	202.7	816.	391.2	0.251	-60.3	304.9
18	206.3	114.	394.3	0.107	-37.9	93.8
19	207.3	0.	-622.9	BELOW	-0.2	0.2

```
CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION     =        0.00  (= 0.242E-02)
     SHOULD NOT EXCEED     0.100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION   =        0.00  (= 0.293E-02)
     SHOULD NOT EXCEED     0.100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN =        0.63  (= 0.632E+00)
     SHOULD NOT EXCEED     0.100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM    =        0.00  (= 0.142E-02)
     SHOULD NOT EXCEED     0.100E+03

END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED
```

760. Reclamation Plan (R645-301-700)

R645-301-761: General Requirements

Within the disturbed area of the Deer Creek Mine are three drainages: Deer Creek Canyon, Deer Canyon and Elk Canyon. The Deer Creek Canyon is by far the largest drainage with Elk Canyon next. The channels in these drainage systems will be restored in their original location as close as possible. All three drainage systems converge within the planned reclamation area of the Deer Creek Mine (see Drawing DS-1780-D).

Mining has created a large fill structure that is used for parking, material storage and necessary facilities to mine coal. Reclamation consists of leaving this fill in place and constructing a flood channel over the top of it while following the natural drainage of the canyons. The main channel will be located on the south side of the existing mine access road. The road parallels the toe of the slope of the old Deer Creek refuse site.

Design, location, construction and materials are carefully chosen to ensure stable channelization. As illustrated in Drawing DS-1781-D in **Appendix R645-301-500-A**, final reclamation activities will follow a reclamation sequence. The Deer Creek Canyon, Deer Canyon and Elk Canyon channels will be reconstructed utilizing a riprapped trapezoidal channel design of sufficient size to accommodate a 100 year, 6 hour storm event. Transitional drainage areas (i.e. drainage entering and leaving the disturbed channels) are illustrated on Figure 7-1A in **Appendix R645-301-700-B**.

As outlined in R645-301-553: Backfilling and Grading, the CMP culvert in the Deer Creek Canyon will be removed in sections. Although the canyon is considered ephermal, flow typically occurs. If during reclamation, flow is found to occur in this canyon, the water will be diverted during channel construction. This will be accomplished using a sediment trap and a 12" flexible culvert. The trap will be utilized as a dam while the culvert will route the water around the reclamation work for a distance determined by the contractor. It will then drop back into the undisturbed CMP culvert below the work area.

Sediment Control Measures for Reclamation as pertained to R645-301-752

After each section is backfilled and graded, sediment transport will be controlled as required by R645-301-552.100 and R645-301-742 of the Utah Coal Regs. Best Technology Currently Available (BTCA) measures will utilize deep gouging (pocking) techniques. These techniques require a track-hoe or similar machine to roughen the disturbed area in a random and discontinuous fashion using the bucket. Pockmarks created are approximately 3.0' feet in diameter and 1.5' feet deep. The pockmarks are designed to capture or trap precipitation, influencing infiltration. Gouging serves to control erosion through water retention, thus enhancing vegetation growth. Because of the water retaining capabilities of deep gouging techniques, contributions of sediment beyond background levels are not expected to contribute suspended solids and sediment to receiving streams.

Drainage that occurs in the disturbed area from a storm event will also be treated. When disturbed culverts are removed, the remaining end of the culvert will be left opened. A berm will be constructed to route runoff towards the culvert inlet. A sediment trap will be placed in front of the culvert inlet so that runoff will be treated before entering the disturbed culvert. This treatment will keep most of the soil on the reclaim slope area and out of the pond. Runoff will be treated again as it enters the sediment pond.

The intent of the sediment control measures used are to prevent, to the extent possible, additional contributions of sediment to the stream outside of the disturbed area. To estimate the amount of sediment that might reach the receiving stream outside the permit area, the Revised Universal Soil Loss Equation (RUSLE) was used to model sediment loss from the reclaimed area. The estimate is then compared to the historical Total Suspended Solids found from analysis at a sample site above the disturbed area. This comparison will help determine the effectiveness of the BTCA for sediment control.

R645-301-752.230: Sediment Loss

Sediment loss was calculated, using RUSLE ver. 1.06, to determine if reclamation practices would cause or contribute to the degradation of downstream water quality. RUSLE is a set of mathematical equations that estimates soil loss and sediment yield resulting from rill and interrill erosion. This empirically derived value was then compared to real sediment loss data (total suspended solids) collected yearly at permanent collection locations. The equation uses the factors as follows:

A=RKLSCP

Where:

A	=	Average annual soil loss in tons per acre per year
R	=	Rainfall/runoff erosivity
K	=	Soil erodibility
LS	=	Hillslope length and steepness
C	=	Cover management
P	=	Support practice

Sediment loss for the Deer Creek Mine was determined by calculating the sediment loss from a detailed area of the proposed mine site reclamation. Drawing DS-1795-D in **Appendix R645-301-700-C** shows this area and where each calculation was made. Slope profiles were placed on runoff plains within the reclaimed area. The areas were divided according to the direction of runoff. Each profile was identified by area (A1, A2, or A3), number of profile (1-5), and characterized as disturbed (D). A typical profile name might be A1-2D. That is area 1, second slope profile in the disturbed.

The area selected to calculate sediment loss is considered representative for the entire disturbed drainage area. In other words, the average loss is determined from the reclaimed areas and then multiplied by an acreage factor. The RUSLE program is found in **Appendix R645-301-700-C** on the 3.5" floppy disk labeled RUSLE, Deer Creek Mine, Input Parameters for Soil Loss Calculations. A review of the files will present all values used to determine sediment loss on the disturbed areas. The RUSLE equation factors mentioned above are discussed below. Table 7-1 summarizes sediment loss calculations used in RUSLE.

The R-factor is the expression of the erosivity of rainfall and runoff. Rainfall data can be found in the City database within RUSLE. The Deer Creek Mine is not one of the monitoring locations found in the program's database. Hiawatha, on the other hand, is found in the database and was chosen because of its similarity to elevation, temperature, orientation, etc., to the Deer Creek Mine. There are sixteen years of meteorological data (1976-1992) recorded in the database. The estimated R-value for this area is 10.

The K-factor is an expression of the inherent erodibility of the soil or surface material at the Deer Creek Mine. Soil material in the fills (disturbed area) was originally derived from sandstone and shale parent materials from the pre-SMCRA terrace areas above the minesite in the Deer Creek Canyon. Chemical analysis of the terrace areas was conducted in fall of 1999 to estimate the chemical characteristics of the facility bench. The data (average of % sand, silt, and clay of all sampling conducted on the terrace benches) from these samples was used to calculate the K-factor for the disturbed areas of the mine (refer to **Appendix R645-301-200-C** to review this data). Since no data was available for % rock cover to calculate the K-factor, a similar area recently reclaimed was needed. The average % rock cover of the fifteen (15) sample sites of the reclaimed slope in the Cottonwood Fan Portal area (refer to 1999 Annual Vegetation Report, pg. 243) was used. This area was reclaimed in 1998 and is similar in elevation and soil composition to the Deer Creek Mine site. The K-factor estimated for the reclaimed disturbed areas of the Deer Creek Mine is 0.225.

Topography was taken into account when calculating the LS-factor. This factor takes the hillslope length (L) and gradient (S) as contributing to erosion. If either one of these factors increase, total soil loss per unit area will also increase. Various lengths and gradients were used in each profile and are shown on Drawing DS-1795-D in **Appendix R645-301-700-C**.

The cover-factor (C) was determined for the soil in a disturbed state. An disturbed state in this case is the condition of the soil immediately after reclamation. In this condition, there is no effective root mass, no canopy cover and no height in which a raindrop can fall from or be intercepted by vegetation. The maximum roughness, however, was used in this calculation since deep pocking is proposed over the entire reclamation site. Other ground cover entries were also used such as rock fragments and vegetative residue (i.e. straw or wood fiber mulch). These entries were conservatively used since no data has been established.

The support practice (P) factor is important when calculating for the disturbed area. It allows credit for creating closed outlet terraces or sediment basins (i.e. pocking) spaced evenly along the hillslope profile.

Listed below in Table 7-1 are the values used to calculate sediment loss from the disturbed areas immediately after reclamation is completed.

The table indicates sediment contributions from the disturbed areas of the Deer Creek Mine. Table 7-1a shows that the average sediment loss from the reclaimed area is estimated at 1.57e-2 tons/acre/year or based on 95.79 acres of disturbance, 1.51 tons/year. It is assumed the remainder of the reclaimed disturbed area will be similar to the study area.

The undisturbed acreage within the watershed is approximately 3064 acres. A comparison was made with data collected between 1984 and 1999 from the sample site above the Deer Creek Mine (DCR01 in the undisturbed drainage). Total Suspended Solids (TSS) values between this time period averaged 99.3 mg/L. This represents mostly springtime runoff since the sample locations are frozen over during the winter and rarely flow during the late summer and fall. Flow was assumed to be the average springtime flow of 2 cfs. Converting these two values to tons/year, the sediment loss equates to 195.2 tons/year. Comparing this value to the sediment loss realized in the proposed reclamation area of the Deer Creek Mine using RUSLE, it is shown that sediment contribution to the Huntington Drainage system is negligible.

Table 7-1: Soil loss calculations of the Deer Creek Mine reclaimed area utilizing RUSLE.

Location*	A1-1D	A1-2D	A2-1D	A2-2D	A2-3D	A2-4D	A3-1D
R	10	10	10	10	10	10	10
K	0.225	0.225	0.225	0.225	0.225	0.225	0.225
LS	3.313	4.421	8.566	4.854	7.594	15.24	15.85
C	0.0415	0.0360	0.0297	0.0395	0.0334	0.0270	0.0271
P	0.031	0.032	0.031	0.031	0.031	0.031	0.031
A	**9.59e-03**	**1.15e-02**	**1.77e-02**	**1.34e-02**	**1.77e-02**	**2.87e-02**	**1.15e-02**

- Refer to Drawing DS-1795-D in **Appendix R645-301-700-C** for the location of each hillslope profile. **Average soil loss = 1.57e-2 tons/acre/acre**. The RUSLE program included in the appendix presents the parameters used to obtain the values in this table.

As part of the final reclamation, the sediment pond will be removed. This will be accomplished by filling the pond with nearby fill material and stabilizing it. Compaction will minimize settling and retain structural integrity of the fill area. The Deer Creek channel will be routed over the fill area to the natural drainage system. The sediment pond will be removed after all other reclamation work above it has been completed. As the sediment pond is being removed, flow will be diverted to the undisturbed culvert, which lies to the north of the pond. Upon completion of the pond reclamation and channel restoration, flow will be restored in the new channel and the remainder of the undisturbed culvert will be excavated.

R645-301-762: Roads

The fan pad access road will be reclaimed as reclamation activities proceed down the Deer Creek Canyon. The mine access road will also be reclaimed, as it is no longer needed for hauling fill material. The mine access road will be removed to the point where the county road terminates in the canyon. At this point, a vehicle turn-around will be developed.

The road accessing the C1 and C2 beltline will be restored as outlined in the cross-section of Drawing DS-1782-D in **Appendix R645-301-500-C**. The culvert passing under the C1 beltline access road will be removed and the channel returned to its original position.

R645-301-762.100: Restoration of Natural Drainage Patterns in reference to R645-301-740

As mentioned above, channels of the three drainage's will be restored to their original location as close as possible. The restored main channel (Deer Creek) will have varying bottom widths from 10 to 15 feet and side slopes of 2h:1v. The side channels (Deer and Elk canyons) will also have varying bottom widths and 2h:1v side slopes. Channel design calculations are discussed below.

Discharge Methodologies

Before channel design can begin, peak runoff flows must be determined. Runoff depth resulting from a given rainfall event was determined utilizing the United States Soil Conservation Service (SCS) methods. According to the curve number methodology, the relationship between storm rainfall, soil moisture storage, and runoff can be expressed by the equations:

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S} \tag{1}$$

$$CN = \frac{1000}{10 + S} \tag{2}$$

Where,

Q = direct runoff depth (inches)
P = storm rainfall depth (inches)
S = maximum infiltration depth (inches)
CN = Curve Number

Determination of runoff from Equation 1 is only valid when $P \geq 0.2S$. Below this point, no runoff can occur.

Estimates of the peak discharge were made using the unit hydrograph procedure developed by the SCS. Figure 7-1 shows a runoff hydrograph and the associated terminology.

Use of Equations 1 and 2 require the selection of a curve number, which is a function of vegetative cover, hydrologic soil groups, and Antecedent Moisture Conditions (AMC). Curve number information for the area was taken, when possible, from previous soil and vegetative surveys. Modifications to, or additional curve numbers used were obtained according to information found using Table 7-1 of the SCS National Engineering Handbook (1972), Section 4, Chapter 7. Vegetation information contained in the MRP indicates that the cover type is Pinyon-Juniper with approximately 40% ground cover density. Figure 7-2, also obtained from the SCS handbook illustrates the relationship of curve number to ground cover density for a Juniper-Grass complex.

The P value was determined using the NOAA Atlas 2, Volume VI-Utah, Precipitation-Frequency

Atlas of the Western United States (1973). This value was found to be 2.4 inches for the designed 100 year / 6 hour storm event.

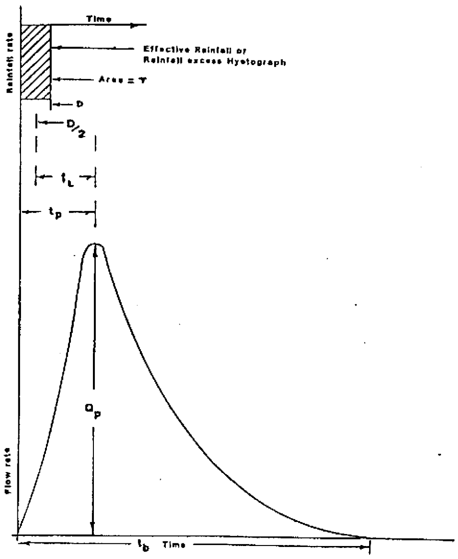

Figure 1. Unit hydrograph terminology.

A hyetograph of a single block of rainfall excess with duration *D* is shown in the upper portion of Figure 7-1. The lower portion of the figure contains the resultant runoff hydrograph. For runoff from excess rainfall, the area under the hydrographic curve and the area enclosed by the rainfall hyetograph represent the same volume of water *Q*. The peak flow rate for the hydrograph is represented by *Qp*. The base time tb is the duration of the hydrograph. The time from the center of mass of rainfall excess to the peak of the runoff hydrograph is the lag time t_L. The time of concentration t_c, (not shown on Figure 7-1) is defined as the time required for flow from the hydraulically most remote point in a basin to reach the basin outlet.

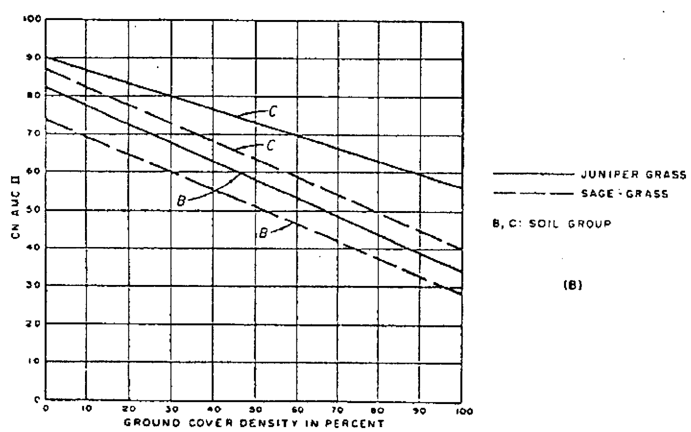

Figure 7-2: Variation of CN with ground cover density and hydrologic soil group for forest-range in the Western United States (taken and recreated from the USDA Soil Conservation Service, 1972).

The time to peak t_p, is assumed to be a function of watershed lag t_L, which is determined according to the equation:

$$t_L = \frac{l^{0.8}(S+1)^{0.7}}{1900\sqrt{Y}} \tag{3}$$

Where,

t_L = watershed lag time (hrs.)
l = hydraulic length of the mainstream to the farthest divide (ft)
Y = Average watershed slope (%)

and S is as previously defined. Values of Y were obtained using the topographic map CM-10529-EM in **Appendix R645-301-700-B**. The hydraulic length was taken from same map, while S was determined from Equation 2 once the curve number had been estimated.

According to the SCS, the watershed lag time is equal to $0.6t_c$ and the time of concentration tc is equal to $1.5t_p$. By combining these two expressions, it can be seen that:

$$t_p = 1.11t_L \tag{4}$$

where both variables are as previously defined.

The peak discharge constant used in the dimensionless unit hydrograph method is determined according to the equation:

$$q_p = \frac{484AQ}{t_p} \tag{5}$$

Where,

q_p = unit hydrograph peak flow rate (cfs)
A = drainage area (sq. mi.)
Q = runoff depth (Equation 1)
484 = conversion factor

and t_p is as previously defined in hours.

Stream flow peaks from the watershed subdrainage areas are shown in Table 7-2 below. These values were obtained from the storm runoff hydrograph found in **Appendix R645-301-700-A**.

Table 7-2: Deer Creek Watershed Runoff Characteristics.

Watershed Sub-area*	Area (acres)	Curve Number	Hydraulic Length (ft)	Elevation Change (ft)	Average Slope (%)	100 Year/6 Hour Event (cfs)
IV	2,493.0	69	18,500.0	2500.0	13.5	65.03
V	119.0	91	4,100.0	1400.0	34.0	84.83
VI	452.0	76	7,200.0	1800.0	25.0	94.44

* See Drawing CM-10529-EM in **Appendix R645-301-700- B**.

Table 7-2 accurately represents the Deer Creek Canyon, Deer Canyon, and Elk Canyon drainage systems. The construction of the hydrographs for these watersheds utilized STORM® for determining flows from a 100-yr./6-hr. storm event. Five storm hydrographs were constructed. One for each drainage, one routing the Deer Canyon into the Deer Creek Canyon, and one routing all three systems. Channel design employs the information gathered from these five hydrographs.

Open Channel Design

Open channel development began by routing the Deer Creek Canyon, Deer Canyon, and Elk Canyon drainage from their point of entrance in the reclamation area to their point of exit. The final reclamation channel is presented in Drawing DS-1780-D in **Appendix R645-301-700-B**. Once the basic channels were routed, stations were located and identified every 100 feet down each reach. At these station locations, the elevation and distance was determined. Using this information, the average slope of each reach was calculated. The slope of the channel is incorporated into the mathematical design utilizing open channel flow equations, such as the Manning's equation.

Open channel design was determined using the SCS method (Haan et. al. 1994). The SCS method expresses velocity as a function of riprap diameter. The procedure is based on a chart that can be approximated by

$$D_{50} = 9d^{1.1}S \tag{6}$$

or

$$d_{\max} = \left(\frac{D_{50}}{9S}\right)^{0.91} \tag{7}$$

Where

d_{max} = maximum depth of flow in the channel.
D_{50} = riprap diameter (ft) such that 50% of the stones have a diameter smaller than D_{50}.
S = Slope

The SCS also presented a chart based on the Isbash curves, which can be approximated by the expression

$$v = 12.84\,D_{50}^{0.51} \tag{8}$$

If Equation 6 is substituted into Equation 8, a velocity analogous to the Manning's equation becomes the resultant.

Since $Q = vA$, and the area A of a trapezoidal channel is $Bd + Zd2$, where B is an assumed bottom width and Z is the ratio of the side slopes (2:1), the diameter of riprap for the channel can be calculated. Thus, the Manning's equation becomes

$$Q = 12.84\,D_{50}^{0.51}\left[B\left(\frac{D_{50}}{9S}\right)^{0.91} + 2\left(\left(\frac{D_{50}}{9S}\right)^{0.91}\right)^{2}\right] \tag{9}$$

As mentioned above, the channel bottom width was assumed. This is not exactly a correct statement. Haestad Methods *FlowMaster*® (version 5.13) was used to determine a workable bottom width, depth and velocity. The idea was to determine these parameters of the channel while keeping in mind the economics of constructing the channel. Having to remove a large quantity of material to cut a channel would increase construction costs. Likewise, keeping the channel shallow and wide would increase costs by involving more riprap work. Thus, a trial and error method in FlowMaster® was utilized to determine the ideal channel parameters.

Mannings "n" used in the *FlowMaste*r model, was calculated using $n = 0.395(D_{50})1/6$ (Haan et. al. 1994) for the Deer Creek riprapped channels. The maximum n found using this equation was 0.044. This equation was used to calculate the roughness coefficients for all riprapped portions of the channel. For the portion of the channel not lined with riprapped, the roughness coefficient was estimated using table values found in *Stream Corridor Restoration*, a document prepared by the Federal Interagency Stream Restoration Working Group. The correction process starts with a base value (n_b) for a straight, uniform, smooth channel in natural materials. This base value is then adjusted to account for channel irregularities, vegetation, obstructions, and sinuosity of the channel. The n for the unlined channels at the Deer Creek Mine adjusted to 0.046.

Trapezoidal channel design results are presented in **Appendix R645-301-700-D**. Table 7-3 summarizes the channel dimensions, expected flow characteristics, and the D_{50} riprap requirements of the three channels that exist at the Deer Creek Mine.

Table 7-3: Table summarizing the designed watershed drainage channels that exist at the Deer Creek Mine.

Station		Channel Slope (%)	Bottom Width (ft)	Side Slope (H:V)	Flow Depth (ft)	Mannings n	Flow Area (ft^2)	Wetted Parameter (ft)	Velocity (fps)	Critical Depth (ft)	Froude Number	Calculated D_{50} (ft)	Channel Depth (ft)	Riprap Thickness (ft)
From	To													
Deer Creek Drainage Q = 65.03 cfs														
0+00	7+28	25	10	2:1	0.52	0.040	5.80	12.35	11.22	1.02	2.86	1.04	1.50	2.00
7+28	8+60	10	10	2:1	0.65	0.036	7.29	12.89	8.93	1.02	2.07	0.57	1.50	1.00
8+60	13+93	2	10	2:1	1.18	0.046	14.65	15.30	4.44	1.02	0.78	unlined	2.00	---
Deer Creek Drainage Q = 103.38 cfs														
13+93	16+10	12	10	2:1	0.84	0.039	9.81	13.76	10.54	1.36	2.17	0.89	2.00	2.00
16+10	20+72	18	10	2:1	0.77	0.041	8.87	13.44	11.6	1.36	2.50	1.16	1.50	2.50
20+72	23+34	22	10	2:1	0.73	0.041	8.30	13.24	12.45	1.36	2.74	1.32	1.50	2.50
Deer Creek Drainage Q = 184.31 cfs														
23+34	25+44	20	10	2:1	1.08	0.044	13.20	14.85	13.96	1.92	2.56	1.86	2.00	4.00
25+44	32+00	6	15	2:1	1.12	0.037	19.23	19.99	9.59	1.56	1.70	0.65	2.00	1.50
Deer Canyon Drainage Q = 84.83 cfs														
0+00	2+43	21	10	2:1	0.65	0.040	7.29	12.89	11.64	1.20	2.70	1.12	1.50	2.50
2+43	8+29	3	15	2:1	0.99	0.046	16.74	19.41	5.07	0.95	0.99	unlined	2.00	---
Elk Canyon Drainage Q = 94.44 cfs														
0+00	4+00	5	10	2:1	1.13	0.046	13.83	15.05	6.83	1.2	1.23	unlined	2.00	---
4+00	6+48	17	10	2:1	0.73	0.040	8.83	13.27	11.27	1.28	2.47	1.05	1.50	2.00
6+48	8+63	24	10	2:1	0.67	0.041	7.60	13.00	12.42	1.28	2.83	1.31	1.50	2.50

Riprap filter gradation requirements were determined using the following equations as given by Haan et. al., 1994:

$$\frac{D_{50}(riprap)}{D_{50}(filter)} < 40$$

$$\frac{D_{15}(riprap)}{D_{15}(filter)} < 40$$

$$\frac{D_{15}(riprap)}{D_{85}(filter)} < 5$$

Filter riprap design calculations using the above-described equations for each stream segment of the three channels were found to need riprap filter material sized between ¼ to 1 ½ inches. Tables displaying filter design calculations are presented in **Appendix R645-301-700-E**.

Bioengineered Channels

Three channel reaches within the Deer Creek Mine disturbed area exist that have slopes less than 5%. While steeper slopes will be protected with riprap armament, these reaches will integrate living woody and herbaceous materials with organic and inorganic material to increase the strength of the soil (Bentrup and Hoag, 1998).

Various techniques will be incorporated to aid in the protection of the streambanks, facilitate sedimentation, and establish a protective vegetal stand. These techniques include 1) wing deflectors, log litter or riprap piles to divert flow to the center of the stream away from the bank, 2) boulder clusters that create scours to dissipate energy for a reduction in flow velocities, 3) "U" and "V" shaped weirs which facilitates sedimentation, 4) willow waddles and/or pole plantings to encourages site specific growth clusters for bank or stream bottom protection, flow velocity reductions, and sedimentation. A typical design for each "soft" reach is located on Figure 7-2A in **Appendix R645-301-700-B**.

To ensure the "soft" reach of the channel will be stable to withstand expected flow velocities during precipitation events, a sieve analysis, according to the ASTM Standard C-136, will be performed at random locations. The sieve analysis determines the percent by weight of particles of material for various sizes. The particle size data will be used to predict the ability of the streambed to resist the erosive forces of flowing water. If it is found that the particle size of the streambed is not sufficient in controlling down cutting erosion, then the design of the stream channel will be modified to either control flow velocities or better armor the streambed.

Energy Dissipation

To protect riprap channels from possible failure caused by high velocity, high energy flows, heavily armored energy dissipation basins are designed at specific channel transition areas. Channel transition areas are areas in which the upstream steep slope (producing supercritical flow) converges onto a mild nearly flat slope (producing subcritical flow). At these transition areas, a hydraulic jump occurs.

Hydraulic jumps are accompanied by a great deal of turbulence and energy dissipation (Haan et.al., 1994). As hydraulic jumps occur at a specified location, hydraulic structures (energy dissipation basins) are used within the channel to add drag forces to the flow.

The hydraulic jump can be defined by the equation:

$$\frac{y_1}{y_2} = \frac{1}{2}\left[-1 + \sqrt{1 + \frac{8V_2^2}{gy_2}}\right] \qquad (10)$$

where,

y_2 = depth of jump (ft)
y_1 = sequent depth (ft)
V_2 = Down stream velocity (ft/s) or Q/A, where Q is in cfs and A = area of trapezoidal channel (ft^2).
g = acceleration due to gravity (32.2 ft/s)

Initially, it is not known if the jump occurs on the steep slope (y_1 > the normal upstream depth) or the mild slope. In these calculations it is assumed that the jump occurs on the mild slope by using down stream values in Equation 10. Once the assumption is justified the location of the jump can be calculated using Equation 11.

$$\Delta x = \frac{E_{i+1} - E_i}{S_o - \bar{S}} \qquad (11)$$

where E_i and E_{i+1} represent specific energy at locations along the channel separated by a distance Δx. S_o represents the initial slope of the down stream side of the transition, while $\bar{S}$ is the average slope at each end of the channel reach. Calculations for dissipation basins in the Deer Creek drainage at approximately 8+60 and Deer drainage at approximately 2+43 are found in **Appendix R645-301-700-B**.

A third energy dissipation basin is place at the confluence of the Deer Creek Canyon and Elk Canyon drainages. This basin will be heavily armored with riprap and widened. Basin design is found in **Appendix R45-301-700-B** on Figure 7-3A. No hydraulic jump will exist along this reach of the channel since only supercritical flows occur.

Diversion of Miscellaneous Flows

Any groundwater water source that emanates from within the disturbed boundary of the Deer Creek Mine will be diverted. A drain will be designed to collect ground water seepage and divert it to the reclaimed channel. This will be accomplished by the use of a French drain system. A typical French drain is illustrated on Drawing DS-1780-D. At present, one spring exists within the disturbed area and is located on Drawing DS-1780-D. A mine discharge is planned at time of reclamation as discussed in **R645-301-500: Engineering**. The discharge design is also illustrated on the above mentioned drawing. Monitoring of the mine discharge will be conducted as required by the UPDES permit. Surface water sites will be monitored for baseline parameters during the fifth (5^{th}) and ninth (9^{th}) years after final reclamation. In no case will baseline sampling time frame exceed 5 years converting from operational to reclamation monitoring. The applicant commits to conduct annual surveys to identify any new discharge locations within and below sealed portals. If discharge occurs, one water sample will be collected and analyzed per location quarterly. Parameters analyzed are those listed in the DOGM Guidelines for Groundwater Water Quality (see Table #2, Appendix A, Volume 9, Hydrologic Section).

R645-301-763: Siltation Structures

All siltation structures (fences, traps, etc.) will be removed by the completion of reclamation. Because of the reclamation techniques used, sediment will be retained within the disturbed area and therefore, no siltation structures will be needed.

Sediment control structures used to control sediment during the reclamation phase are outlined on Figure 7-4A in **Appendix R645-301-700-B**.

R645-301-764: Structure Removal

A timetable has been constructed for the removal of all structures at the Deer Creek Mine. Included in the table is the sediment pond. See **R645-301-300: Biology** for more information.

R645-301-765: Permanent Casing and Sealing of Wells

Each water well will be cased, sealed, or otherwise managed, as approved by the Division.

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Soil Conservation Service, US Department of Agriculture, SCS National Engineering Handbook, Section 4, 1972.

Miller, et.al., NOAA Atlas 2, Precipitation-Frequency Atlas of the Western United States, Vol. VI-Utah, US Department of Commerce, 1973.

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Bentrup, Gary and Hoag, Chris, The practical Streambank Bioengineering Guide, The Interagency Riparian, May 1998.

Stream Corridor Restoration, Inter-governmental Agency Cooperation, Http://www.usda.gov/stream_restoration, pgs. 7-19 through 7-22.

Software

STORM, Version 6.21, Office of Surface Mining Watershed Model, Gary McIntosh, Copyright, Borland International, 1987, 1988.

FlowMaster for Windows, Version 5.13, Professional Edition, Copyright, Haestad Methods, Inc., 1994 - 1995.

RUSLE, Version 1.06, Office of Surface Mining Sediment Loss Model, T.J. Toy & G.R. Foster, 1998.

PACIFICORP

ENERGY WEST MINING

Deer Creek Mine
C/015/018
Mining and Reclamation Plan

Appendix R645-301-700-A

Watershed Hydrographs for Deer Creek, Deer, and Elk Canyons

Deer Creek Canyon Watershed Hydrograph

Project Title = Deer Creek Mine Hydrograph
WATERSHED HYDROGRAPH
Inflow into structure # 1
Structure type: Null

-- Watershed data for watershed # 1
Curve number = 69.0
Area = 2493.0 acres
Hydraulic length = 18500.00 Feet
Elevation change = 2500.0 feet.
Concentration time = 5.53 hours
Concentration time type = SCS Upland Curves
Unit hydrograph type = Forested

-- Total Area = 2493.0 acres

-- Storm data
Total precipitation = 2.4 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 65.03 cfs
Discharge volume = 78.13 acre ft

time (hr.)	rainfall (in.)	hydrograph (cfs)		time (hr.)	rainfall (in.)	hydrograph (cfs)
0.00	0.000	0.000	*	0.10	0.015	0.000
0.20	0.015	0.000	*	0.30	0.015	0.000
0.40	0.015	0.000	*	0.50	0.015	0.000
0.60	0.023	0.000	*	0.70	0.023	0.000
0.80	0.023	0.000	*	0.90	0.023	0.000
1.00	0.023	0.000	*	1.10	0.025	0.000
1.20	0.025	0.000	*	1.30	0.025	0.000
1.40	0.025	0.000	*	1.50	0.025	0.000
1.60	0.046	0.000	*	1.70	0.046	0.000
1.80	0.046	0.000	*	1.90	0.046	0.000
2.00	0.046	0.000	*	2.10	0.179	0.000
2.20	0.179	0.000	*	2.30	0.179	0.043
2.40	0.179	0.203	*	2.50	0.179	0.546
2.60	0.048	0.950	*	2.70	0.048	1.417
2.80	0.048	1.952	*	2.90	0.048	2.560
3.00	0.048	3.243	*	3.10	0.038	3.989
3.20	0.038	4.801	*	3.30	0.038	5.681
3.40	0.038	6.632	*	3.50	0.038	7.654
3.60	0.026	8.728	*	3.70	0.026	9.854
3.80	0.026	11.033	*	3.90	0.026	12.266
4.00	0.026	13.554	*	4.10	0.024	14.891
4.20	0.024	16.279	*	4.30	0.024	17.718
4.40	0.024	19.210	*	4.50	0.024	20.754
4.60	0.019	22.341	*	4.70	0.019	23.973
4.80	0.019	25.649	*	4.90	0.019	27.369
5.00	0.019	29.136	*	5.10	0.017	30.943
5.20	0.017	32.792	*	5.30	0.017	34.683
5.40	0.017	36.616	*	5.50	0.017	38.592
5.60	0.019	40.596	*	5.70	0.019	42.563
5.80	0.019	44.402	*	5.90	0.019	46.113
6.00	0.019	47.797	*	6.10	0.000	49.398

time (hr.)	rainfall (in.)	hydrograph (cfs)		time (hr.)	rainfall (in.)	hydrograph (cfs)
17.30	0.000	18.459				
17.40	0.000	18.147	*	17.50	0.000	17.847
17.60	0.000	17.560	*	17.70	0.000	17.287
17.80	0.000	17.027	*	17.90	0.000	16.779
18.00	0.000	16.543	*	18.10	0.000	16.320
18.20	0.000	16.109	*	18.30	0.000	15.911
18.40	0.000	15.724	*	18.50	0.000	15.548
18.60	0.000	15.383	*	18.70	0.000	15.228
18.80	0.000	15.085	*	18.90	0.000	14.951
19.00	0.000	14.828	*	19.10	0.000	14.715
19.20	0.000	14.612	*	19.30	0.000	14.520
19.40	0.000	14.439	*	19.50	0.000	14.370
19.60	0.000	14.312	*	19.70	0.000	14.267
19.80	0.000	14.233	*	19.90	0.000	14.202
20.00	0.000	14.170	*	20.10	0.000	14.138
20.20	0.000	14.106	*	20.30	0.000	14.074
20.40	0.000	14.043	*	20.50	0.000	14.011
20.60	0.000	13.979	*	20.70	0.000	13.947
20.80	0.000	13.916	*	20.90	0.000	13.884
21.00	0.000	13.852	*	21.10	0.000	13.820
21.20	0.000	13.788	*	21.30	0.000	13.757
21.40	0.000	13.725	*	21.50	0.000	13.693
21.60	0.000	13.661	*	21.70	0.000	13.630
21.80	0.000	13.598	*	21.90	0.000	13.566
22.00	0.000	13.534	*	22.10	0.000	13.502
22.20	0.000	13.471	*	22.30	0.000	13.439
22.40	0.000	13.407	*	22.50	0.000	13.375
22.60	0.000	13.343	*	22.70	0.000	13.312
22.80	0.000	13.280	*	22.90	0.000	13.248
23.00	0.000	13.216	*	23.10	0.000	13.185
23.20	0.000	13.153	*	23.30	0.000	13.121
23.40	0.000	13.089	*	23.50	0.000	13.057
23.60	0.000	13.026	*	23.70	0.000	12.994
23.80	0.000	12.962	*	23.90	0.000	12.930
24.00	0.000	12.899	*	24.10	0.000	12.867
24.20	0.000	12.835	*	24.30	0.000	12.803
24.40	0.000	12.771	*	24.50	0.000	12.740
24.60	0.000	12.708	*	24.70	0.000	12.676
24.80	0.000	12.644	*	24.90	0.000	12.613
25.00	0.000	12.581	*	25.10	0.000	12.549
25.20	0.000	12.517	*	25.30	0.000	12.485
25.40	0.000	12.454	*	25.50	0.000	12.422
25.60	0.000	12.390	*	25.70	0.000	12.358
25.80	0.000	12.327	*	25.90	0.000	12.295
26.00	0.000	12.263	*	26.10	0.000	12.231
26.20	0.000	12.199	*	26.30	0.000	12.168
26.40	0.000	12.136	*	26.50	0.000	12.104
26.60	0.000	12.072	*	26.70	0.000	12.040
26.80	0.000	12.009	*	26.90	0.000	11.977
27.00	0.000	11.945	*	27.10	0.000	11.913
27.20	0.000	11.882	*	27.30	0.000	11.850
27.40	0.000	11.818	*	27.50	0.000	11.786
27.60	0.000	11.754	*	27.70	0.000	11.723
27.80	0.000	11.691	*	27.90	0.000	11.659
28.00	0.000	11.627	*	28.10	0.000	11.596
28.20	0.000	11.564	*	28.30	0.000	11.532

time (hr.)	rainfall (in.)	hydrograph (cfs)		time (hr.)	rainfall (in.)	hydrograph (cfs)
6.10	0.000	49.398				
6.20	0.000	50.912	*	6.30	0.000	52.334
6.40	0.000	53.666	*	6.50	0.000	54.917
6.60	0.000	56.085	*	6.70	0.000	57.166
6.80	0.000	58.158	*	6.90	0.000	59.068
7.00	0.000	59.914	*	7.10	0.000	60.694
7.20	0.000	61.406	*	7.30	0.000	62.051
7.40	0.000	62.628	*	7.50	0.000	63.142
7.60	0.000	63.593	*	7.70	0.000	63.979
7.80	0.000	64.299	*	7.90	0.000	64.557
8.00	0.000	64.760	*	8.10	0.000	64.908
8.20	0.000	64.999	*	8.30	0.000	65.034
8.40	0.000	65.014	*	8.50	0.000	64.941
8.60	0.000	64.816	*	8.70	0.000	64.639
8.80	0.000	64.408	*	8.90	0.000	64.121
9.00	0.000	63.773	*	9.10	0.000	63.365
9.20	0.000	62.896	*	9.30	0.000	62.365
9.40	0.000	61.793	*	9.50	0.000	61.222
9.60	0.000	60.650	*	9.70	0.000	60.078
9.80	0.000	59.507	*	9.90	0.000	58.935
10.00	0.000	58.363	*	10.10	0.000	57.792
10.20	0.000	57.220	*	10.30	0.000	56.648
10.40	0.000	56.077	*	10.50	0.000	55.505
10.60	0.000	54.933	*	10.70	0.000	54.362
10.80	0.000	53.790	*	10.90	0.000	53.218
11.00	0.000	52.647	*	11.10	0.000	52.075
11.20	0.000	51.503	*	11.30	0.000	50.932
11.40	0.000	50.360	*	11.50	0.000	49.788
11.60	0.000	49.217	*	11.70	0.000	48.645
11.80	0.000	48.073	*	11.90	0.000	47.502
12.00	0.000	46.930	*	12.10	0.000	46.358
12.20	0.000	45.787	*	12.30	0.000	45.215
12.40	0.000	44.643	*	12.50	0.000	44.072
12.60	0.000	43.500	*	12.70	0.000	42.928
12.80	0.000	42.357	*	12.90	0.000	41.785
13.00	0.000	41.214	*	13.10	0.000	40.642
13.20	0.000	40.070	*	13.30	0.000	39.499
13.40	0.000	38.927	*	13.50	0.000	38.355
13.60	0.000	37.784	*	13.70	0.000	37.212
13.80	0.000	36.640	*	13.90	0.000	36.069
14.00	0.000	35.497	*	14.10	0.000	34.925
14.20	0.000	34.354	*	14.30	0.000	33.782
14.40	0.000	33.210	*	14.50	0.000	32.639
14.60	0.000	32.067	*	14.70	0.000	31.495
14.80	0.000	30.924	*	14.90	0.000	30.352
15.00	0.000	29.780	*	15.10	0.000	29.209
15.20	0.000	28.637	*	15.30	0.000	28.065
15.40	0.000	27.494	*	15.50	0.000	26.922
15.60	0.000	26.350	*	15.70	0.000	25.779
15.80	0.000	25.207	*	15.90	0.000	24.635
16.00	0.000	24.064	*	16.10	0.000	23.501
16.20	0.000	22.964	*	16.30	0.000	22.470
16.40	0.000	21.994	*	16.50	0.000	21.534
16.60	0.000	21.090	*	16.70	0.000	20.664
16.80	0.000	20.255	*	16.90	0.000	19.863
17.00	0.000	19.487	*	17.10	0.000	19.127

time (hr.)	rainfall (in.)	hydrograph (cfs)		time (hr.)	rainfall (in.)	hydrograph (cfs)
28.50	0.000	11.468				
28.60	0.000	11.437	*	28.70	0.000	11.405
28.80	0.000	11.373	*	28.90	0.000	11.341
29.00	0.000	11.310	*	29.10	0.000	11.278
29.20	0.000	11.246	*	29.30	0.000	11.214
29.40	0.000	11.182	*	29.50	0.000	11.151
29.60	0.000	11.119	*	29.70	0.000	11.087
29.80	0.000	11.055	*	29.90	0.000	11.023
30.00	0.000	10.992	*	30.10	0.000	10.960
30.20	0.000	10.928	*	30.30	0.000	10.896
30.40	0.000	10.865	*	30.50	0.000	10.833
30.60	0.000	10.801	*	30.70	0.000	10.769
30.80	0.000	10.737	*	30.90	0.000	10.706
31.00	0.000	10.674	*	31.10	0.000	10.642
31.20	0.000	10.610	*	31.30	0.000	10.579
31.40	0.000	10.547	*	31.50	0.000	10.515
31.60	0.000	10.483	*	31.70	0.000	10.451
31.80	0.000	10.420	*	31.90	0.000	10.388
32.00	0.000	10.356	*	32.10	0.000	10.324
32.20	0.000	10.293	*	32.30	0.000	10.261
32.40	0.000	10.229	*	32.50	0.000	10.197
32.60	0.000	10.165	*	32.70	0.000	10.134
32.80	0.000	10.102	*	32.90	0.000	10.070
33.00	0.000	10.038	*	33.10	0.000	10.007
33.20	0.000	9.975	*	33.30	0.000	9.943
33.40	0.000	9.911	*	33.50	0.000	9.879
33.60	0.000	9.848	*	33.70	0.000	9.816
33.80	0.000	9.784	*	33.90	0.000	9.752
34.00	0.000	9.720	*	34.10	0.000	9.689
34.20	0.000	9.657	*	34.30	0.000	9.625
34.40	0.000	9.593	*	34.50	0.000	9.562
34.60	0.000	9.530	*	34.70	0.000	9.498
34.80	0.000	9.466	*	34.90	0.000	9.434
35.00	0.000	9.403	*	35.10	0.000	9.371
35.20	0.000	9.339	*	35.30	0.000	9.307
35.40	0.000	9.276	*	35.50	0.000	9.244
35.60	0.000	9.212	*	35.70	0.000	9.180
35.80	0.000	9.148	*	35.90	0.000	9.117
36.00	0.000	9.085	*	36.10	0.000	9.053
36.20	0.000	9.021	*	36.30	0.000	8.990
36.40	0.000	8.958	*	36.50	0.000	8.926
36.60	0.000	8.894	*	36.70	0.000	8.862
36.80	0.000	8.831	*	36.90	0.000	8.799
37.00	0.000	8.767	*	37.10	0.000	8.735
37.20	0.000	8.703	*	37.30	0.000	8.672
37.40	0.000	8.640	*	37.50	0.000	8.608
37.60	0.000	8.576	*	37.70	0.000	8.545
37.80	0.000	8.513	*	37.90	0.000	8.481
38.00	0.000	8.449	*	38.10	0.000	8.417
38.20	0.000	8.386	*	38.30	0.000	8.354
38.40	0.000	8.322	*	38.50	0.000	8.290
38.60	0.000	8.259	*	38.70	0.000	8.227
38.80	0.000	8.195	*	38.90	0.000	8.163
39.00	0.000	8.131	*	39.10	0.000	8.100
39.20	0.000	8.068	*	39.30	0.000	8.036
39.40	0.000	8.004	*	39.50	0.000	7.973

time (hr.)	rainfall (in.)	hydrograph (cfs)		time (hr.)	rainfall (in.)	hydrograph (cfs)
39.70	0.000	7.909				
39.80	0.000	7.877	*	39.90	0.000	7.845
40.00	0.000	7.814	*	40.10	0.000	7.782
40.20	0.000	7.750	*	40.30	0.000	7.718
40.40	0.000	7.687	*	40.50	0.000	7.655
40.60	0.000	7.623	*	40.70	0.000	7.591
40.80	0.000	7.559	*	40.90	0.000	7.528
41.00	0.000	7.496	*	41.10	0.000	7.464
41.20	0.000	7.432	*	41.30	0.000	7.400
41.40	0.000	7.369	*	41.50	0.000	7.337
41.60	0.000	7.305	*	41.70	0.000	7.273
41.80	0.000	7.242	*	41.90	0.000	7.210
42.00	0.000	7.178	*	42.10	0.000	7.146
42.20	0.000	7.114	*	42.30	0.000	7.083
42.40	0.000	7.051	*	42.50	0.000	7.019
42.60	0.000	6.987	*	42.70	0.000	6.956
42.80	0.000	6.924	*	42.90	0.000	6.892
43.00	0.000	6.860	*	43.10	0.000	6.828
43.20	0.000	6.797	*	43.30	0.000	6.765
43.40	0.000	6.733	*	43.50	0.000	6.701
43.60	0.000	6.670	*	43.70	0.000	6.638
43.80	0.000	6.606	*	43.90	0.000	6.574
44.00	0.000	6.542	*	44.10	0.000	6.511
44.20	0.000	6.479	*	44.30	0.000	6.447
44.40	0.000	6.415	*	44.50	0.000	6.384
44.60	0.000	6.352	*	44.70	0.000	6.320
44.80	0.000	6.288	*	44.90	0.000	6.256
45.00	0.000	6.225	*	45.10	0.000	6.193
45.20	0.000	6.161	*	45.30	0.000	6.129
45.40	0.000	6.097	*	45.50	0.000	6.066
45.60	0.000	6.034	*	45.70	0.000	6.002
45.80	0.000	5.970	*	45.90	0.000	5.939
46.00	0.000	5.907	*	46.10	0.000	5.875
46.20	0.000	5.843	*	46.30	0.000	5.811
46.40	0.000	5.780	*	46.50	0.000	5.748
46.60	0.000	5.716	*	46.70	0.000	5.684
46.80	0.000	5.653	*	46.90	0.000	5.621
47.00	0.000	5.589	*	47.10	0.000	5.557
47.20	0.000	5.525	*	47.30	0.000	5.494
47.40	0.000	5.462	*	47.50	0.000	5.430
47.60	0.000	5.398	*	47.70	0.000	5.367
47.80	0.000	5.335	*	47.90	0.000	5.303
48.00	0.000	5.271	*	48.10	0.000	5.239
48.20	0.000	5.208	*	48.30	0.000	5.176
48.40	0.000	5.144	*	48.50	0.000	5.112
48.60	0.000	5.080	*	48.70	0.000	5.049
48.80	0.000	5.017	*	48.90	0.000	4.985
49.00	0.000	4.953	*	49.10	0.000	4.922
49.20	0.000	4.890	*	49.30	0.000	4.858
49.40	0.000	4.826	*	49.50	0.000	4.794
49.60	0.000	4.763	*	49.70	0.000	4.731
49.80	0.000	4.699	*	49.90	0.000	4.667
50.00	0.000	4.636	*	50.10	0.000	4.604
50.20	0.000	4.572	*	50.30	0.000	4.540
50.40	0.000	4.508	*	50.50	0.000	4.477
50.60	0.000	4.445	*	50.70	0.000	4.413

time (hr.)	rainfall (in.)	hydrograph (cfs)		time (hr.)	rainfall (in.)	hydrograph (cfs)
50.90	0.000	4.350				
51.00	0.000	4.318	*	51.10	0.000	4.286
51.20	0.000	4.254	*	51.30	0.000	4.222
51.40	0.000	4.191	*	51.50	0.000	4.159
51.60	0.000	4.127	*	51.70	0.000	4.095
51.80	0.000	4.064	*	51.90	0.000	4.032
52.00	0.000	4.000	*	52.10	0.000	3.968
52.20	0.000	3.936	*	52.30	0.000	3.905
52.40	0.000	3.873	*	52.50	0.000	3.841
52.60	0.000	3.809	*	52.70	0.000	3.777
52.80	0.000	3.746	*	52.90	0.000	3.714
53.00	0.000	3.682	*	53.10	0.000	3.650
53.20	0.000	3.619	*	53.30	0.000	3.587
53.40	0.000	3.555	*	53.50	0.000	3.523
53.60	0.000	3.491	*	53.70	0.000	3.460
53.80	0.000	3.428	*	53.90	0.000	3.396
54.00	0.000	3.364	*	54.10	0.000	3.333
54.20	0.000	3.301	*	54.30	0.000	3.269
54.40	0.000	3.237	*	54.50	0.000	3.205
54.60	0.000	3.174	*	54.70	0.000	3.142
54.80	0.000	3.110	*	54.90	0.000	3.078
55.00	0.000	3.047	*	55.10	0.000	3.015
55.20	0.000	2.983	*	55.30	0.000	2.951
55.40	0.000	2.919	*	55.50	0.000	2.888
55.60	0.000	2.856	*	55.70	0.000	2.824
55.80	0.000	2.792	*	55.90	0.000	2.760
56.00	0.000	2.729	*	56.10	0.000	2.697
56.20	0.000	2.665	*	56.30	0.000	2.633
56.40	0.000	2.602	*	56.50	0.000	2.570
56.60	0.000	2.538	*	56.70	0.000	2.506
56.80	0.000	2.474	*	56.90	0.000	2.443
57.00	0.000	2.411	*	57.10	0.000	2.379
57.20	0.000	2.347	*	57.30	0.000	2.316
57.40	0.000	2.284	*	57.50	0.000	2.252
57.60	0.000	2.220	*	57.70	0.000	2.188
57.80	0.000	2.157	*	57.90	0.000	2.125
58.00	0.000	2.093	*	58.10	0.000	2.061
58.20	0.000	2.030	*	58.30	0.000	1.998
58.40	0.000	1.966	*	58.50	0.000	1.934
58.60	0.000	1.902	*	58.70	0.000	1.871
58.80	0.000	1.839	*	58.90	0.000	1.807
59.00	0.000	1.775	*	59.10	0.000	1.744
59.20	0.000	1.712	*	59.30	0.000	1.680
59.40	0.000	1.648	*	59.50	0.000	1.616
59.60	0.000	1.585	*	59.70	0.000	1.553
59.80	0.000	1.521	*	59.90	0.000	1.489
60.00	0.000	1.457	*	60.10	0.000	1.426
60.20	0.000	1.394	*	60.30	0.000	1.362
60.40	0.000	1.330	*	60.50	0.000	1.299
60.60	0.000	1.267	*	60.70	0.000	1.235
60.80	0.000	1.203	*	60.90	0.000	1.171
61.00	0.000	1.140	*	61.10	0.000	1.108
61.20	0.000	1.076	*	61.30	0.000	1.044
61.40	0.000	1.013	*	61.50	0.000	0.981
61.60	0.000	0.949	*	61.70	0.000	0.917
61.80	0.000	0.885	*	61.90	0.000	0.854

time (hr.)	rainfall (in.)	hydrograph (cfs)		time (hr.)	rainfall (in.)	hydrograph (cfs)
62.10	0.000	0.790				
62.20	0.000	0.758	*	62.30	0.000	0.727
62.40	0.000	0.695	*	62.50	0.000	0.663
62.60	0.000	0.631	*	62.70	0.000	0.599
62.80	0.000	0.568	*	62.90	0.000	0.536
63.00	0.000	0.504	*	63.10	0.000	0.473
63.20	0.000	0.443	*	63.30	0.000	0.416
63.40	0.000	0.390	*	63.50	0.000	0.365
63.60	0.000	0.341	*	63.70	0.000	0.318
63.80	0.000	0.296	*	63.90	0.000	0.275
64.00	0.000	0.255	*	64.10	0.000	0.235
64.20	0.000	0.217	*	64.30	0.000	0.200
64.40	0.000	0.184	*	64.50	0.000	0.168
64.60	0.000	0.153	*	64.70	0.000	0.139
64.80	0.000	0.126	*	64.90	0.000	0.113
65.00	0.000	0.101	*	65.10	0.000	0.090
65.20	0.000	0.079	*	65.30	0.000	0.070
65.40	0.000	0.061	*	65.50	0.000	0.052
65.60	0.000	0.044	*	65.70	0.000	0.037
65.80	0.000	0.031	*	65.90	0.000	0.025
66.00	0.000	0.019	*	66.10	0.000	0.015
66.20	0.000	0.011	*	66.30	0.000	0.007
66.40	0.000	0.004	*	66.50	0.000	0.002
66.60	0.000	0.001	*	66.70	0.000	0.000
66.80	0.000	0.000	*			

Deer Canyon Watershed Hydrograph

Project Title = Deer Drainage
WATERSHED HYDROGRAPH
Inflow into structure # 1
Structure type: Null

-- Watershed data for watershed # 1

Curve number	=	91.0
Area	=	119.0 acres
Hydraulic length	=	4100.00 Feet
Elevation change	=	1400.0 feet.
Concentration time	=	0.19 hours
Concentration time type	=	SCS Upland Curves
Unit hydrograph type	=	Forested

-- Total Area = 119.0 acres

-- Storm data

Total precipitation	=	2.4 inches
Storm type	=	SCS 6 hour design storm
Peak Discharge	=	84.83 cfs
Discharge volume	=	15.07 acre ft

time (hr.)	rainfall (in.)	hydrograph (cfs)		time (hr.)	rainfall (in.)	hydrograph (cfs)
0.00	0.000	0.000	*	0.10	0.015	0.000
0.20	0.015	0.000	*	0.30	0.015	0.000
0.40	0.015	0.000	*	0.50	0.015	0.000
0.60	0.023	0.000	*	0.70	0.023	0.000
0.80	0.023	0.000	*	0.90	0.023	0.000
1.00	0.023	0.000	*	1.10	0.025	0.044
1.20	0.025	0.250	*	1.30	0.025	0.657
1.40	0.025	1.216	*	1.50	0.025	1.879
1.60	0.046	3.190	*	1.70	0.046	5.070
1.80	0.046	7.090	*	1.90	0.046	9.158
2.00	0.046	11.196	*	2.10	0.179	21.262
2.20	0.179	37.836	*	2.30	0.179	54.687
2.40	0.179	70.620	*	2.50	0.179	84.829
2.60	0.048	84.472	*	2.70	0.048	74.072
2.80	0.048	65.247	*	2.90	0.048	58.463
3.00	0.048	54.054	*	3.10	0.038	51.335
3.20	0.038	50.424	*	3.30	0.038	49.673
3.40	0.038	49.084	*	3.50	0.038	48.663
3.60	0.026	47.222	*	3.70	0.026	45.219
3.80	0.026	43.457	*	3.90	0.026	41.939
4.00	0.026	40.668	*	4.10	0.024	39.358
4.20	0.024	38.089	*	4.30	0.024	36.860
4.40	0.024	35.673	*	4.50	0.024	34.531
4.60	0.019	33.004	*	4.70	0.019	31.268
4.80	0.019	29.635	*	4.90	0.019	28.109
5.00	0.019	26.694	*	5.10	0.017	25.293
5.20	0.017	24.017	*	5.30	0.017	22.963
5.40	0.017	22.147	*	5.50	0.017	21.582
5.60	0.019	21.328	*	5.70	0.019	21.270
5.80	0.019	21.202	*	5.90	0.019	21.124
6.00	0.019	21.037	*	6.10	0.000	18.941

time (hr.)	rainfall (in.)	hydrograph (cfs)		time (hr.)	rainfall (in.)	hydrograph (cfs)
6.10	0.000	18.941				
6.20	0.000	15.668	*	6.30	0.000	12.928
6.40	0.000	10.723	*	6.50	0.000	9.054
6.60	0.000	7.907	*	6.70	0.000	7.210
6.80	0.000	6.551	*	6.90	0.000	5.929
7.00	0.000	5.345	*	7.10	0.000	4.795
7.20	0.000	4.279	*	7.30	0.000	3.797
7.40	0.000	3.350	*	7.50	0.000	2.936
7.60	0.000	2.551	*	7.70	0.000	2.194
7.80	0.000	1.865	*	7.90	0.000	1.563
8.00	0.000	1.290	*	8.10	0.000	1.043
8.20	0.000	0.821	*	8.30	0.000	0.624
8.40	0.000	0.453	*	8.50	0.000	0.307
8.60	0.000	0.189	*	8.70	0.000	0.099
8.80	0.000	0.038	*	8.90	0.000	0.005
9.00	0.000	0.000	*			

Elk Canyon Watershed Hydrograph

Project Title = Elk Canyon Drainage
WATERSHED HYDROGRAPH
Inflow into structure # 1
Structure type: Null

-- Watershed data for watershed # 1
Curve number = 76.0
Area = 452.0 acres
Hydraulic length = 7200.00 Feet
Elevation change = 1800.0 feet.
Concentration time = 0.23 hours
Concentration time type = SCS Upland Curves
Unit hydrograph type = Forested

-- Total Area = 452.0 acres

-- Storm data
Total precipitation = 2.4 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 94.44 cfs
Discharge volume = 23.91 acre ft

time (hr.)	rainfall (in.)	hydrograph (cfs)		time (hr.)	rainfall (in.)	hydrograph (cfs)
0.00	0.000	0.000	*	0.10	0.015	0.000
0.20	0.015	0.000	*	0.30	0.015	0.000
0.40	0.015	0.000	*	0.50	0.015	0.000
0.60	0.023	0.000	*	0.70	0.023	0.000
0.80	0.023	0.000	*	0.90	0.023	0.000
1.00	0.023	0.000	*	1.10	0.025	0.000
1.20	0.025	0.000	*	1.30	0.025	0.000
1.40	0.025	0.000	*	1.50	0.025	0.000
1.60	0.046	0.000	*	1.70	0.046	0.000
1.80	0.046	0.000	*	1.90	0.046	0.000
2.00	0.046	0.000	*	2.10	0.179	0.944
2.20	0.178	8.290	*	2.30	0.179	25.563
2.40	0.178	50.411	*	2.50	0.179	80.153
2.60	0.048	94.435	*	2.70	0.048	91.402
2.80	0.048	87.286	*	2.90	0.048	82.600
3.00	0.048	78.621	*	3.10	0.038	75.060
3.20	0.038	73.104	*	3.30	0.038	73.806
3.40	0.038	74.726	*	3.50	0.038	75.884
3.60	0.026	75.256	*	3.70	0.026	73.130
3.80	0.026	71.595	*	3.90	0.026	70.435
4.00	0.026	69.667	*	4.10	0.023	68.784
4.20	0.023	67.876	*	4.30	0.024	67.381
4.40	0.023	66.951	*	4.50	0.023	66.570
4.60	0.019	65.454	*	4.70	0.019	63.724
4.80	0.019	62.214	*	4.90	0.019	60.843
5.00	0.019	59.616	*	5.10	0.017	58.169
5.20	0.017	56.555	*	5.30	0.017	55.097
5.40	0.017	53.688	*	5.50	0.017	52.374
5.60	0.019	51.591	*	5.70	0.019	51.361
5.80	0.019	51.310	*	5.90	0.019	51.383
6.00	0.019	51.409	*	6.10	0.000	47.466

time (hr.)	rainfall (in.)	hydrograph (cfs)		time (hr.)	rainfall (in.)	hydrograph (cfs)
6.10	0.000	47.466				
6.20	0.000	40.172	*	6.30	0.000	33.840
6.40	0.000	28.537	*	6.50	0.000	24.253
6.60	0.000	20.995	*	6.70	0.000	18.771
6.80	0.000	17.285	*	6.90	0.000	15.885
7.00	0.000	14.549	*	7.10	0.000	13.278
7.20	0.000	12.072	*	7.30	0.000	10.932
7.40	0.000	9.858	*	7.50	0.000	8.845
7.60	0.000	7.892	*	7.70	0.000	7.000
7.80	0.000	6.171	*	7.90	0.000	5.402
8.00	0.000	4.685	*	8.10	0.000	4.019
8.20	0.000	3.406	*	8.30	0.000	2.845
8.40	0.000	2.335	*	8.50	0.000	1.874
8.60	0.000	1.461	*	8.70	0.000	1.096
8.80	0.000	0.780	*	8.90	0.000	0.514
9.00	0.000	0.303	*	9.10	0.000	0.146
9.20	0.000	0.045	*			

Combined Watershed Hydrograph

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Project Title          = Convergence of Deer Creek and Deer Cyn.
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null


-- Watershed data for watershed # 1
    Curve number              =    69.0
    Area                      =  2493.0 acres
    Hydraulic length          = 18500.00 Feet
    Elevation change          =  2500.0 feet.
    Concentration time        =    5.53 hours
    Concentration time type   = SCS Upland Curves
    Unit hydrograph type      = Forested


-- Watershed data for watershed # 2
    Curve number              =    91.0
    Area                      =   119.0 acres
    Hydraulic length          = 4100.00 Feet
    Elevation change          =  1400.0 feet.
    Concentration time        =    0.11 hours
    Concentration time type   = SCS Upland Curves
    Unit hydrograph type      = Forested

-- Total Area              =  2612.0 acres

-- Storm data
    Total precipitation   =      2.4 inches
    Storm type            = SCS 6 hour design storm
    Peak Discharge        =  103.38 cfs
    Discharge volume      =   93.20 acre ft
```

time (hr.)	rainfall (in.)	hydrograph (cfs)		time (hr.)	rainfall (in.)	hydrograph (cfs)
0.00	0.000	0.000	*	0.10	0.015	0.000
0.20	0.015	0.000	*	0.30	0.015	0.000
0.40	0.015	0.000	*	0.50	0.015	0.000
0.60	0.023	0.000	*	0.70	0.023	0.000
0.80	0.023	0.000	*	0.90	0.023	0.000
1.00	0.023	0.000	*	1.10	0.025	0.089
1.20	0.025	0.455	*	1.30	0.025	1.053
1.40	0.025	1.791	*	1.50	0.025	2.591
1.60	0.046	4.604	*	1.70	0.046	6.984
1.80	0.046	9.398	*	1.90	0.046	11.693
2.00	0.046	13.795	*	2.10	0.179	32.436
2.20	0.179	54.129	*	2.30	0.179	74.047
2.40	0.179	90.557	*	2.50	0.179	103.376
2.60	0.048	89.877	*	2.70	0.048	75.613
2.80	0.048	66.302	*	2.90	0.048	62.436
3.00	0.048	63.140	*	3.10	0.038	61.889
3.20	0.038	60.643	*	3.30	0.038	59.811
3.40	0.038	59.407	*	3.50	0.038	59.346
3.60	0.026	56.822	*	3.70	0.026	54.373
3.80	0.026	52.526	*	3.90	0.026	51.294
4.00	0.026	50.568	*	4.10	0.024	49.294

time (hr.)	rainfall (in.)	hydrograph (cfs)		time (hr.)	rainfall (in.)	hydrograph (cfs)
4.10	0.024	49.294				
4.20	0.024	48.304	*	4.30	0.024	47.804
4.40	0.024	47.841	*	4.50	0.024	48.419
4.60	0.019	48.546	*	4.70	0.019	48.854
4.80	0.019	49.498	*	4.90	0.019	50.479
5.00	0.019	51.756	*	5.10	0.017	52.751
5.20	0.017	53.861	*	5.30	0.017	55.168
5.40	0.017	56.673	*	5.50	0.017	58.357
5.60	0.019	60.533	*	5.70	0.019	62.683
5.80	0.019	64.628	*	5.90	0.019	66.367
6.00	0.019	68.021	*	6.10	0.000	65.555
6.20	0.000	63.197	*	6.30	0.000	61.800
6.40	0.000	61.367	*	6.50	0.000	61.707
6.60	0.000	62.034	*	6.70	0.000	62.332
6.80	0.000	62.598	*	6.90	0.000	62.839
7.00	0.000	63.073	*	7.10	0.000	63.298
7.20	0.000	63.509	*	7.30	0.000	63.702
7.40	0.000	63.881	*	7.50	0.000	64.048
7.60	0.000	64.204	*	7.70	0.000	64.352
7.80	0.000	64.492	*	7.90	0.000	64.628
8.00	0.000	64.767	*	8.10	0.000	64.908
8.20	0.000	64.999	*	8.30	0.000	65.034
8.40	0.000	65.014	*	8.50	0.000	64.941
8.60	0.000	64.816	*	8.70	0.000	64.639
8.80	0.000	64.408	*	8.90	0.000	64.121
9.00	0.000	63.773	*	9.10	0.000	63.365
9.20	0.000	62.896	*	9.30	0.000	62.365
9.40	0.000	61.793	*	9.50	0.000	61.222
9.60	0.000	60.650	*	9.70	0.000	60.078
9.80	0.000	59.507	*	9.90	0.000	58.935
10.00	0.000	58.363	*	10.10	0.000	57.792
10.20	0.000	57.220	*	10.30	0.000	56.648
10.40	0.000	56.077	*	10.50	0.000	55.505
10.60	0.000	54.933	*	10.70	0.000	54.362
10.80	0.000	53.790	*	10.90	0.000	53.218
11.00	0.000	52.647	*	11.10	0.000	52.075
11.20	0.000	51.503	*	11.30	0.000	50.932
11.40	0.000	50.360	*	11.50	0.000	49.788
11.60	0.000	49.217	*	11.70	0.000	48.645
11.80	0.000	48.073	*	11.90	0.000	47.502
12.00	0.000	46.930	*	12.10	0.000	46.358
12.20	0.000	45.787	*	12.30	0.000	45.215
12.40	0.000	44.643	*	12.50	0.000	44.072
12.60	0.000	43.500	*	12.70	0.000	42.928
12.80	0.000	42.357	*	12.90	0.000	41.785
13.00	0.000	41.214	*	13.10	0.000	40.642
13.20	0.000	40.070	*	13.30	0.000	39.499
13.40	0.000	38.927	*	13.50	0.000	38.355
13.60	0.000	37.784	*	13.70	0.000	37.212
13.80	0.000	36.640	*	13.90	0.000	36.069
14.00	0.000	35.497	*	14.10	0.000	34.925
14.20	0.000	34.354	*	14.30	0.000	33.782
14.40	0.000	33.210	*	14.50	0.000	32.639
14.60	0.000	32.067	*	14.70	0.000	31.495
14.80	0.000	30.924	*	14.90	0.000	30.352
15.00	0.000	29.780	*	15.10	0.000	29.209

time (hr.)	rainfall (in.)	hydrograph (cfs)		time (hr.)	rainfall (in.)	hydrograph (cfs)
15.30	0.000	28.065				
15.40	0.000	27.494	*	15.50	0.000	26.922
15.60	0.000	26.350	*	15.70	0.000	25.779
15.80	0.000	25.207	*	15.90	0.000	24.635
16.00	0.000	24.064	*	16.10	0.000	23.501
16.20	0.000	22.964	*	16.30	0.000	22.470
16.40	0.000	21.994	*	16.50	0.000	21.534
16.60	0.000	21.090	*	16.70	0.000	20.664
16.80	0.000	20.255	*	16.90	0.000	19.863
17.00	0.000	19.487	*	17.10	0.000	19.127
17.20	0.000	18.784	*	17.30	0.000	18.459
17.40	0.000	18.147	*	17.50	0.000	17.847
17.60	0.000	17.560	*	17.70	0.000	17.287
17.80	0.000	17.027	*	17.90	0.000	16.779
18.00	0.000	16.543	*	18.10	0.000	16.320
18.20	0.000	16.109	*	18.30	0.000	15.911
18.40	0.000	15.724	*	18.50	0.000	15.548
18.60	0.000	15.383	*	18.70	0.000	15.228
18.80	0.000	15.085	*	18.90	0.000	14.951
19.00	0.000	14.828	*	19.10	0.000	14.715
19.20	0.000	14.612	*	19.30	0.000	14.520
19.40	0.000	14.439	*	19.50	0.000	14.370
19.60	0.000	14.312	*	19.70	0.000	14.267
19.80	0.000	14.233	*	19.90	0.000	14.202
20.00	0.000	14.170	*	20.10	0.000	14.138
20.20	0.000	14.106	*	20.30	0.000	14.074
20.40	0.000	14.043	*	20.50	0.000	14.011
20.60	0.000	13.979	*	20.70	0.000	13.947
20.80	0.000	13.916	*	20.90	0.000	13.884
21.00	0.000	13.852	*	21.10	0.000	13.820
21.20	0.000	13.788	*	21.30	0.000	13.757
21.40	0.000	13.725	*	21.50	0.000	13.693
21.60	0.000	13.661	*	21.70	0.000	13.630
21.80	0.000	13.598	*	21.90	0.000	13.566
22.00	0.000	13.534	*	22.10	0.000	13.502
22.20	0.000	13.471	*	22.30	0.000	13.439
22.40	0.000	13.407	*	22.50	0.000	13.375
22.60	0.000	13.343	*	22.70	0.000	13.312
22.80	0.000	13.280	*	22.90	0.000	13.248
23.00	0.000	13.216	*	23.10	0.000	13.185
23.20	0.000	13.153	*	23.30	0.000	13.121
23.40	0.000	13.089	*	23.50	0.000	13.057
23.60	0.000	13.026	*	23.70	0.000	12.994
23.80	0.000	12.962	*	23.90	0.000	12.930
24.00	0.000	12.899	*	24.10	0.000	12.867
24.20	0.000	12.835	*	24.30	0.000	12.803
24.40	0.000	12.771	*	24.50	0.000	12.740
24.60	0.000	12.708	*	24.70	0.000	12.676
24.80	0.000	12.644	*	24.90	0.000	12.613
25.00	0.000	12.581	*	25.10	0.000	12.549
25.20	0.000	12.517	*	25.30	0.000	12.485
25.40	0.000	12.454	*	25.50	0.000	12.422
25.60	0.000	12.390	*	25.70	0.000	12.358
25.80	0.000	12.327	*	25.90	0.000	12.295
26.00	0.000	12.263	*	26.10	0.000	12.231
26.20	0.000	12.199	*	26.30	0.000	12.168

time (hr.)	rainfall (in.)	hydrograph (cfs)		time (hr.)	rainfall (in.)	hydrograph (cfs)
26.50	0.000	12.104				
26.60	0.000	12.072	*	26.70	0.000	12.040
26.80	0.000	12.009	*	26.90	0.000	11.977
27.00	0.000	11.945	*	27.10	0.000	11.913
27.20	0.000	11.882	*	27.30	0.000	11.850
27.40	0.000	11.818	*	27.50	0.000	11.786
27.60	0.000	11.754	*	27.70	0.000	11.723
27.80	0.000	11.691	*	27.90	0.000	11.659
28.00	0.000	11.627	*	28.10	0.000	11.596
28.20	0.000	11.564	*	28.30	0.000	11.532
28.40	0.000	11.500	*	28.50	0.000	11.468
28.60	0.000	11.437	*	28.70	0.000	11.405
28.80	0.000	11.373	*	28.90	0.000	11.341
29.00	0.000	11.310	*	29.10	0.000	11.278
29.20	0.000	11.246	*	29.30	0.000	11.214
29.40	0.000	11.182	*	29.50	0.000	11.151
29.60	0.000	11.119	*	29.70	0.000	11.087
29.80	0.000	11.055	*	29.90	0.000	11.023
30.00	0.000	10.992	*	30.10	0.000	10.960
30.20	0.000	10.928	*	30.30	0.000	10.896
30.40	0.000	10.865	*	30.50	0.000	10.833
30.60	0.000	10.801	*	30.70	0.000	10.769
30.80	0.000	10.737	*	30.90	0.000	10.706
31.00	0.000	10.674	*	31.10	0.000	10.642
31.20	0.000	10.610	*	31.30	0.000	10.579
31.40	0.000	10.547	*	31.50	0.000	10.515
31.60	0.000	10.483	*	31.70	0.000	10.451
31.80	0.000	10.420	*	31.90	0.000	10.388
32.00	0.000	10.356	*	32.10	0.000	10.324
32.20	0.000	10.293	*	32.30	0.000	10.261
32.40	0.000	10.229	*	32.50	0.000	10.197
32.60	0.000	10.165	*	32.70	0.000	10.134
32.80	0.000	10.102	*	32.90	0.000	10.070
33.00	0.000	10.038	*	33.10	0.000	10.007
33.20	0.000	9.975	*	33.30	0.000	9.943
33.40	0.000	9.911	*	33.50	0.000	9.879
33.60	0.000	9.848	*	33.70	0.000	9.816
33.80	0.000	9.784	*	33.90	0.000	9.752
34.00	0.000	9.720	*	34.10	0.000	9.689
34.20	0.000	9.657	*	34.30	0.000	9.625
34.40	0.000	9.593	*	34.50	0.000	9.562
34.60	0.000	9.530	*	34.70	0.000	9.498
34.80	0.000	9.466	*	34.90	0.000	9.434
35.00	0.000	9.403	*	35.10	0.000	9.371
35.20	0.000	9.339	*	35.30	0.000	9.307
35.40	0.000	9.276	*	35.50	0.000	9.244
35.60	0.000	9.212	*	35.70	0.000	9.180
35.80	0.000	9.148	*	35.90	0.000	9.117
36.00	0.000	9.085	*	36.10	0.000	9.053
36.20	0.000	9.021	*	36.30	0.000	8.990
36.40	0.000	8.958	*	36.50	0.000	8.926
36.60	0.000	8.894	*	36.70	0.000	8.862
36.80	0.000	8.831	*	36.90	0.000	8.799
37.00	0.000	8.767	*	37.10	0.000	8.735
37.20	0.000	8.703	*	37.30	0.000	8.672
37.40	0.000	8.640	*	37.50	0.000	8.608

time (hr.)	rainfall (in.)	hydrograph (cfs)		time (hr.)	rainfall (in.)	hydrograph (cfs)
37.70	0.000	8.545				
37.80	0.000	8.513	*	37.90	0.000	8.481
38.00	0.000	8.449	*	38.10	0.000	8.417
38.20	0.000	8.386	*	38.30	0.000	8.354
38.40	0.000	8.322	*	38.50	0.000	8.290
38.60	0.000	8.259	*	38.70	0.000	8.227
38.80	0.000	8.195	*	38.90	0.000	8.163
39.00	0.000	8.131	*	39.10	0.000	8.100
39.20	0.000	8.068	*	39.30	0.000	8.036
39.40	0.000	8.004	*	39.50	0.000	7.973
39.60	0.000	7.941	*	39.70	0.000	7.909
39.80	0.000	7.877	*	39.90	0.000	7.845
40.00	0.000	7.814	*	40.10	0.000	7.782
40.20	0.000	7.750	*	40.30	0.000	7.718
40.40	0.000	7.687	*	40.50	0.000	7.655
40.60	0.000	7.623	*	40.70	0.000	7.591
40.80	0.000	7.559	*	40.90	0.000	7.528
41.00	0.000	7.496	*	41.10	0.000	7.464
41.20	0.000	7.432	*	41.30	0.000	7.400
41.40	0.000	7.369	*	41.50	0.000	7.337
41.60	0.000	7.305	*	41.70	0.000	7.273
41.80	0.000	7.242	*	41.90	0.000	7.210
42.00	0.000	7.178	*	42.10	0.000	7.146
42.20	0.000	7.114	*	42.30	0.000	7.083
42.40	0.000	7.051	*	42.50	0.000	7.019
42.60	0.000	6.987	*	42.70	0.000	6.956
42.80	0.000	6.924	*	42.90	0.000	6.892
43.00	0.000	6.860	*	43.10	0.000	6.828
43.20	0.000	6.797	*	43.30	0.000	6.765
43.40	0.000	6.733	*	43.50	0.000	6.701
43.60	0.000	6.670	*	43.70	0.000	6.638
43.80	0.000	6.606	*	43.90	0.000	6.574
44.00	0.000	6.542	*	44.10	0.000	6.511
44.20	0.000	6.479	*	44.30	0.000	6.447
44.40	0.000	6.415	*	44.50	0.000	6.384
44.60	0.000	6.352	*	44.70	0.000	6.320
44.80	0.000	6.288	*	44.90	0.000	6.256
45.00	0.000	6.225	*	45.10	0.000	6.193
45.20	0.000	6.161	*	45.30	0.000	6.129
45.40	0.000	6.097	*	45.50	0.000	6.066
45.60	0.000	6.034	*	45.70	0.000	6.002
45.80	0.000	5.970	*	45.90	0.000	5.939
46.00	0.000	5.907	*	46.10	0.000	5.875
46.20	0.000	5.843	*	46.30	0.000	5.811
46.40	0.000	5.780	*	46.50	0.000	5.748
46.60	0.000	5.716	*	46.70	0.000	5.684
46.80	0.000	5.653	*	46.90	0.000	5.621
47.00	0.000	5.589	*	47.10	0.000	5.557
47.20	0.000	5.525	*	47.30	0.000	5.494
47.40	0.000	5.462	*	47.50	0.000	5.430
47.60	0.000	5.398	*	47.70	0.000	5.367
47.80	0.000	5.335	*	47.90	0.000	5.303
48.00	0.000	5.271	*	48.10	0.000	5.239
48.20	0.000	5.208	*	48.30	0.000	5.176
48.40	0.000	5.144	*	48.50	0.000	5.112
48.60	0.000	5.080	*	48.70	0.000	5.049

time (hr.)	rainfall (in.)	hydrograph (cfs)		time (hr.)	rainfall (in.)	hydrograph (cfs)
48.90	0.000	4.985				
49.00	0.000	4.953	*	49.10	0.000	4.922
49.20	0.000	4.890	*	49.30	0.000	4.858
49.40	0.000	4.826	*	49.50	0.000	4.794
49.60	0.000	4.763	*	49.70	0.000	4.731
49.80	0.000	4.699	*	49.90	0.000	4.667
50.00	0.000	4.636	*	50.10	0.000	4.604
50.20	0.000	4.572	*	50.30	0.000	4.540
50.40	0.000	4.508	*	50.50	0.000	4.477
50.60	0.000	4.445	*	50.70	0.000	4.413
50.80	0.000	4.381	*	50.90	0.000	4.350
51.00	0.000	4.318	*	51.10	0.000	4.286
51.20	0.000	4.254	*	51.30	0.000	4.222
51.40	0.000	4.191	*	51.50	0.000	4.159
51.60	0.000	4.127	*	51.70	0.000	4.095
51.80	0.000	4.064	*	51.90	0.000	4.032
52.00	0.000	4.000	*	52.10	0.000	3.968
52.20	0.000	3.936	*	52.30	0.000	3.905
52.40	0.000	3.873	*	52.50	0.000	3.841
52.60	0.000	3.809	*	52.70	0.000	3.777
52.80	0.000	3.746	*	52.90	0.000	3.714
53.00	0.000	3.682	*	53.10	0.000	3.650
53.20	0.000	3.619	*	53.30	0.000	3.587
53.40	0.000	3.555	*	53.50	0.000	3.523
53.60	0.000	3.491	*	53.70	0.000	3.460
53.80	0.000	3.428	*	53.90	0.000	3.396
54.00	0.000	3.364	*	54.10	0.000	3.333
54.20	0.000	3.301	*	54.30	0.000	3.269
54.40	0.000	3.237	*	54.50	0.000	3.205
54.60	0.000	3.174	*	54.70	0.000	3.142
54.80	0.000	3.110	*	54.90	0.000	3.078
55.00	0.000	3.047	*	55.10	0.000	3.015
55.20	0.000	2.983	*	55.30	0.000	2.951
55.40	0.000	2.919	*	55.50	0.000	2.888
55.60	0.000	2.856	*	55.70	0.000	2.824
55.80	0.000	2.792	*	55.90	0.000	2.760
56.00	0.000	2.729	*	56.10	0.000	2.697
56.20	0.000	2.665	*	56.30	0.000	2.633
56.40	0.000	2.602	*	56.50	0.000	2.570
56.60	0.000	2.538	*	56.70	0.000	2.506
56.80	0.000	2.474	*	56.90	0.000	2.443
57.00	0.000	2.411	*	57.10	0.000	2.379
57.20	0.000	2.347	*	57.30	0.000	2.316
57.40	0.000	2.284	*	57.50	0.000	2.252
57.60	0.000	2.220	*	57.70	0.000	2.188
57.80	0.000	2.157	*	57.90	0.000	2.125
58.00	0.000	2.093	*	58.10	0.000	2.061
58.20	0.000	2.030	*	58.30	0.000	1.998
58.40	0.000	1.966	*	58.50	0.000	1.934
58.60	0.000	1.902	*	58.70	0.000	1.871
58.80	0.000	1.839	*	58.90	0.000	1.807
59.00	0.000	1.775	*	59.10	0.000	1.744
59.20	0.000	1.712	*	59.30	0.000	1.680
59.40	0.000	1.648	*	59.50	0.000	1.616
59.60	0.000	1.585	*	59.70	0.000	1.553
59.80	0.000	1.521	*	59.90	0.000	1.489

time (hr.)	rainfall (in.)	hydrograph (cfs)		time (hr.)	rainfall (in.)	hydrograph (cfs)
60.10	0.000	1.426				
60.20	0.000	1.394	*	60.30	0.000	1.362
60.40	0.000	1.330	*	60.50	0.000	1.299
60.60	0.000	1.267	*	60.70	0.000	1.235
60.80	0.000	1.203	*	60.90	0.000	1.171
61.00	0.000	1.140	*	61.10	0.000	1.108
61.20	0.000	1.076	*	61.30	0.000	1.044
61.40	0.000	1.013	*	61.50	0.000	0.981
61.60	0.000	0.949	*	61.70	0.000	0.917
61.80	0.000	0.885	*	61.90	0.000	0.854
62.00	0.000	0.822	*	62.10	0.000	0.790
62.20	0.000	0.758	*	62.30	0.000	0.727
62.40	0.000	0.695	*	62.50	0.000	0.663
62.60	0.000	0.631	*	62.70	0.000	0.599
62.80	0.000	0.568	*	62.90	0.000	0.536
63.00	0.000	0.504	*	63.10	0.000	0.473
63.20	0.000	0.443	*	63.30	0.000	0.416
63.40	0.000	0.390	*	63.50	0.000	0.365
63.60	0.000	0.341	*	63.70	0.000	0.318
63.80	0.000	0.296	*	63.90	0.000	0.275
64.00	0.000	0.255	*	64.10	0.000	0.235
64.20	0.000	0.217	*	64.30	0.000	0.200
64.40	0.000	0.184	*	64.50	0.000	0.168
64.60	0.000	0.153	*	64.70	0.000	0.139
64.80	0.000	0.126	*	64.90	0.000	0.113
65.00	0.000	0.101	*	65.10	0.000	0.090
65.20	0.000	0.079	*	65.30	0.000	0.070
65.40	0.000	0.061	*	65.50	0.000	0.052
65.60	0.000	0.044	*	65.70	0.000	0.037
65.80	0.000	0.031	*	65.90	0.000	0.025
66.00	0.000	0.019	*	66.10	0.000	0.015
66.20	0.000	0.011	*	66.30	0.000	0.007
66.40	0.000	0.004	*	66.50	0.000	0.002
66.60	0.000	0.001	*	66.70	0.000	0.000
66.80	0.000	0.000	*			

Project Title = Combination of Deer Creek, Deer, and Elk
WATERSHED HYDROGRAPH
Inflow into structure # 1
Structure type: Null

-- Watershed data for watershed # 1
Curve number = 69.0
Area = 2493.0 acres
Hydraulic length = 18500.00 Feet
Elevation change = 2500.0 feet.
Concentration time = 5.53 hours
Concentration time type = SCS Upland Curves
Unit hydrograph type = Forested

-- Watershed data for watershed # 2
Curve number = 91.0
Area = 119.0 acres
Hydraulic length = 4100.00 Feet
Elevation change = 1400.0 feet.
Concentration time = 0.11 hours
Concentration time type = SCS Upland Curves
Unit hydrograph type = Forested

-- Watershed data for watershed # 3
Curve number = 76.0
Area = 452.0 acres
Hydraulic length = 7200.00 Feet
Elevation change = 1800.0 feet.
Concentration time = 0.23 hours
Concentration time type = SCS Upland Curves
Unit hydrograph type = Forested

-- Total Area = 3064.0 acres

-- Storm data
Total precipitation = 2.4 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 184.31 cfs
Discharge volume = 117.11 acre ft

time (hr.)	rainfall (in.)	hydrograph (cfs)		time (hr.)	rainfall (in.)	hydrograph (cfs)
0.00	0.000	0.000	*	0.10	0.015	0.000
0.20	0.015	0.000	*	0.30	0.015	0.000
0.40	0.015	0.000	*	0.50	0.015	0.000
0.60	0.023	0.000	*	0.70	0.023	0.000
0.80	0.023	0.000	*	0.90	0.023	0.000
1.00	0.023	0.000	*	1.10	0.025	0.089
1.20	0.025	0.455	*	1.30	0.025	1.053
1.40	0.025	1.791	*	1.50	0.025	2.591
1.60	0.046	4.604	*	1.70	0.046	6.984
1.80	0.046	9.398	*	1.90	0.046	11.693
2.00	0.046	13.795	*	2.10	0.179	33.379

time (hr.)	rainfall (in.)	hydrograph (cfs)		time (hr.)	rainfall (in.)	hydrograph (cfs)
2.10	0.179	33.379				
2.20	0.179	62.419	*	2.30	0.179	99.609
2.40	0.179	140.971	*	2.50	0.179	183.533
2.60	0.048	184.312	*	2.70	0.048	167.014
2.80	0.048	153.587	*	2.90	0.048	145.034
3.00	0.048	141.761	*	3.10	0.038	136.948
3.20	0.038	133.747	*	3.30	0.038	133.617
3.40	0.038	134.133	*	3.50	0.038	135.230
3.60	0.026	132.078	*	3.70	0.026	127.503
3.80	0.026	124.121	*	3.90	0.026	121.729
4.00	0.026	120.235	*	4.10	0.024	118.082
4.20	0.024	116.190	*	4.30	0.024	115.183
4.40	0.024	114.779	*	4.50	0.024	114.985
4.60	0.019	114.001	*	4.70	0.019	112.578
4.80	0.019	111.712	*	4.90	0.019	111.324
5.00	0.019	111.374	*	5.10	0.017	110.917
5.20	0.017	110.406	*	5.30	0.017	110.268
5.40	0.017	110.375	*	5.50	0.017	110.735
5.60	0.019	112.125	*	5.70	0.019	114.044
5.80	0.019	115.937	*	5.90	0.019	117.748
6.00	0.019	119.428	*	6.10	0.000	113.021
6.20	0.000	103.370	*	6.30	0.000	95.640
6.40	0.000	89.904	*	6.50	0.000	85.960
6.60	0.000	83.029	*	6.70	0.000	81.103
6.80	0.000	79.883	*	6.90	0.000	78.724
7.00	0.000	77.622	*	7.10	0.000	76.576
7.20	0.000	75.581	*	7.30	0.000	74.635
7.40	0.000	73.739	*	7.50	0.000	72.893
7.60	0.000	72.096	*	7.70	0.000	71.352
7.80	0.000	70.663	*	7.90	0.000	70.030
8.00	0.000	69.451	*	8.10	0.000	68.927
8.20	0.000	68.405	*	8.30	0.000	67.879
8.40	0.000	67.349	*	8.50	0.000	66.815
8.60	0.000	66.277	*	8.70	0.000	65.735
8.80	0.000	65.188	*	8.90	0.000	64.635
9.00	0.000	64.076	*	9.10	0.000	63.512
9.20	0.000	62.942	*	9.30	0.000	62.365
9.40	0.000	61.793	*	9.50	0.000	61.222
9.60	0.000	60.650	*	9.70	0.000	60.078
9.80	0.000	59.507	*	9.90	0.000	58.935
10.00	0.000	58.363	*	10.10	0.000	57.792
10.20	0.000	57.220	*	10.30	0.000	56.648
10.40	0.000	56.077	*	10.50	0.000	55.505
10.60	0.000	54.933	*	10.70	0.000	54.362
10.80	0.000	53.790	*	10.90	0.000	53.218
11.00	0.000	52.647	*	11.10	0.000	52.075
11.20	0.000	51.503	*	11.30	0.000	50.932
11.40	0.000	50.360	*	11.50	0.000	49.788
11.60	0.000	49.217	*	11.70	0.000	48.645
11.80	0.000	48.073	*	11.90	0.000	47.502
12.00	0.000	46.930	*	12.10	0.000	46.358
12.20	0.000	45.787	*	12.30	0.000	45.215
12.40	0.000	44.643	*	12.50	0.000	44.072
12.60	0.000	43.500	*	12.70	0.000	42.928
12.80	0.000	42.357	*	12.90	0.000	41.785
13.00	0.000	41.214	*	13.10	0.000	40.642

time (hr.)	rainfall (in.)	hydrograph (cfs)		time (hr.)	rainfall (in.)	hydrograph (cfs)
13.30	0.000	39.499				
13.40	0.000	38.927	*	13.50	0.000	38.355
13.60	0.000	37.784	*	13.70	0.000	37.212
13.80	0.000	36.640	*	13.90	0.000	36.069
14.00	0.000	35.497	*	14.10	0.000	34.925
14.20	0.000	34.354	*	14.30	0.000	33.782
14.40	0.000	33.210	*	14.50	0.000	32.639
14.60	0.000	32.067	*	14.70	0.000	31.495
14.80	0.000	30.924	*	14.90	0.000	30.352
15.00	0.000	29.780	*	15.10	0.000	29.209
15.20	0.000	28.637	*	15.30	0.000	28.065
15.40	0.000	27.494	*	15.50	0.000	26.922
15.60	0.000	26.350	*	15.70	0.000	25.779
15.80	0.000	25.207	*	15.90	0.000	24.635
16.00	0.000	24.064	*	16.10	0.000	23.501
16.20	0.000	22.964	*	16.30	0.000	22.470
16.40	0.000	21.994	*	16.50	0.000	21.534
16.60	0.000	21.090	*	16.70	0.000	20.664
16.80	0.000	20.255	*	16.90	0.000	19.863
17.00	0.000	19.487	*	17.10	0.000	19.127
17.20	0.000	18.784	*	17.30	0.000	18.459
17.40	0.000	18.147	*	17.50	0.000	17.847
17.60	0.000	17.560	*	17.70	0.000	17.287
17.80	0.000	17.027	*	17.90	0.000	16.779
18.00	0.000	16.543	*	18.10	0.000	16.320
18.20	0.000	16.109	*	18.30	0.000	15.911
18.40	0.000	15.724	*	18.50	0.000	15.548
18.60	0.000	15.383	*	18.70	0.000	15.228
18.80	0.000	15.085	*	18.90	0.000	14.951
19.00	0.000	14.828	*	19.10	0.000	14.715
19.20	0.000	14.612	*	19.30	0.000	14.520
19.40	0.000	14.439	*	19.50	0.000	14.370
19.60	0.000	14.312	*	19.70	0.000	14.267
19.80	0.000	14.233	*	19.90	0.000	14.202
20.00	0.000	14.170	*	20.10	0.000	14.138
20.20	0.000	14.106	*	20.30	0.000	14.074
20.40	0.000	14.043	*	20.50	0.000	14.011
20.60	0.000	13.979	*	20.70	0.000	13.947
20.80	0.000	13.916	*	20.90	0.000	13.884
21.00	0.000	13.852	*	21.10	0.000	13.820
21.20	0.000	13.788	*	21.30	0.000	13.757
21.40	0.000	13.725	*	21.50	0.000	13.693
21.60	0.000	13.661	*	21.70	0.000	13.630
21.80	0.000	13.598	*	21.90	0.000	13.566
22.00	0.000	13.534	*	22.10	0.000	13.502
22.20	0.000	13.471	*	22.30	0.000	13.439
22.40	0.000	13.407	*	22.50	0.000	13.375
22.60	0.000	13.343	*	22.70	0.000	13.312
22.80	0.000	13.280	*	22.90	0.000	13.248
23.00	0.000	13.216	*	23.10	0.000	13.185
23.20	0.000	13.153	*	23.30	0.000	13.121
23.40	0.000	13.089	*	23.50	0.000	13.057
23.60	0.000	13.026	*	23.70	0.000	12.994
23.80	0.000	12.962	*	23.90	0.000	12.930
24.00	0.000	12.899	*	24.10	0.000	12.867
24.20	0.000	12.835	*	24.30	0.000	12.803

time (hr.)	rainfall (in.)	hydrograph (cfs)		time (hr.)	rainfall (in.)	hydrograph (cfs)
24.50	0.000	12.740				
24.60	0.000	12.708	*	24.70	0.000	12.676
24.80	0.000	12.644	*	24.90	0.000	12.613
25.00	0.000	12.581	*	25.10	0.000	12.549
25.20	0.000	12.517	*	25.30	0.000	12.485
25.40	0.000	12.454	*	25.50	0.000	12.422
25.60	0.000	12.390	*	25.70	0.000	12.358
25.80	0.000	12.327	*	25.90	0.000	12.295
26.00	0.000	12.263	*	26.10	0.000	12.231
26.20	0.000	12.199	*	26.30	0.000	12.168
26.40	0.000	12.136	*	26.50	0.000	12.104
26.60	0.000	12.072	*	26.70	0.000	12.040
26.80	0.000	12.009	*	26.90	0.000	11.977
27.00	0.000	11.945	*	27.10	0.000	11.913
27.20	0.000	11.882	*	27.30	0.000	11.850
27.40	0.000	11.818	*	27.50	0.000	11.786
27.60	0.000	11.754	*	27.70	0.000	11.723
27.80	0.000	11.691	*	27.90	0.000	11.659
28.00	0.000	11.627	*	28.10	0.000	11.596
28.20	0.000	11.564	*	28.30	0.000	11.532
28.40	0.000	11.500	*	28.50	0.000	11.468
28.60	0.000	11.437	*	28.70	0.000	11.405
28.80	0.000	11.373	*	28.90	0.000	11.341
29.00	0.000	11.310	*	29.10	0.000	11.278
29.20	0.000	11.246	*	29.30	0.000	11.214
29.40	0.000	11.182	*	29.50	0.000	11.151
29.60	0.000	11.119	*	29.70	0.000	11.087
29.80	0.000	11.055	*	29.90	0.000	11.023
30.00	0.000	10.992	*	30.10	0.000	10.960
30.20	0.000	10.928	*	30.30	0.000	10.896
30.40	0.000	10.865	*	30.50	0.000	10.833
30.60	0.000	10.801	*	30.70	0.000	10.769
30.80	0.000	10.737	*	30.90	0.000	10.706
31.00	0.000	10.674	*	31.10	0.000	10.642
31.20	0.000	10.610	*	31.30	0.000	10.579
31.40	0.000	10.547	*	31.50	0.000	10.515
31.60	0.000	10.483	*	31.70	0.000	10.451
31.80	0.000	10.420	*	31.90	0.000	10.388
32.00	0.000	10.356	*	32.10	0.000	10.324
32.20	0.000	10.293	*	32.30	0.000	10.261
32.40	0.000	10.229	*	32.50	0.000	10.197
32.60	0.000	10.165	*	32.70	0.000	10.134
32.80	0.000	10.102	*	32.90	0.000	10.070
33.00	0.000	10.038	*	33.10	0.000	10.007
33.20	0.000	9.975	*	33.30	0.000	9.943
33.40	0.000	9.911	*	33.50	0.000	9.879
33.60	0.000	9.848	*	33.70	0.000	9.816
33.80	0.000	9.784	*	33.90	0.000	9.752
34.00	0.000	9.720	*	34.10	0.000	9.689
34.20	0.000	9.657	*	34.30	0.000	9.625
34.40	0.000	9.593	*	34.50	0.000	9.562
34.60	0.000	9.530	*	34.70	0.000	9.498
34.80	0.000	9.466	*	34.90	0.000	9.434
35.00	0.000	9.403	*	35.10	0.000	9.371
35.20	0.000	9.339	*	35.30	0.000	9.307
35.40	0.000	9.276	*	35.50	0.000	9.244

time (hr.)	rainfall (in.)	hydrograph (cfs)		time (hr.)	rainfall (in.)	hydrograph (cfs)
35.70	0.000	9.180				
35.80	0.000	9.148	*	35.90	0.000	9.117
36.00	0.000	9.085	*	36.10	0.000	9.053
36.20	0.000	9.021	*	36.30	0.000	8.990
36.40	0.000	8.958	*	36.50	0.000	8.926
36.60	0.000	8.894	*	36.70	0.000	8.862
36.80	0.000	8.831	*	36.90	0.000	8.799
37.00	0.000	8.767	*	37.10	0.000	8.735
37.20	0.000	8.703	*	37.30	0.000	8.672
37.40	0.000	8.640	*	37.50	0.000	8.608
37.60	0.000	8.576	*	37.70	0.000	8.545
37.80	0.000	8.513	*	37.90	0.000	8.481
38.00	0.000	8.449	*	38.10	0.000	8.417
38.20	0.000	8.386	*	38.30	0.000	8.354
38.40	0.000	8.322	*	38.50	0.000	8.290
38.60	0.000	8.259	*	38.70	0.000	8.227
38.80	0.000	8.195	*	38.90	0.000	8.163
39.00	0.000	8.131	*	39.10	0.000	8.100
39.20	0.000	8.068	*	39.30	0.000	8.036
39.40	0.000	8.004	*	39.50	0.000	7.973
39.60	0.000	7.941	*	39.70	0.000	7.909
39.80	0.000	7.877	*	39.90	0.000	7.845
40.00	0.000	7.814	*	40.10	0.000	7.782
40.20	0.000	7.750	*	40.30	0.000	7.718
40.40	0.000	7.687	*	40.50	0.000	7.655
40.60	0.000	7.623	*	40.70	0.000	7.591
40.80	0.000	7.559	*	40.90	0.000	7.528
41.00	0.000	7.496	*	41.10	0.000	7.464
41.20	0.000	7.432	*	41.30	0.000	7.400
41.40	0.000	7.369	*	41.50	0.000	7.337
41.60	0.000	7.305	*	41.70	0.000	7.273
41.80	0.000	7.242	*	41.90	0.000	7.210
42.00	0.000	7.178	*	42.10	0.000	7.146
42.20	0.000	7.114	*	42.30	0.000	7.083
42.40	0.000	7.051	*	42.50	0.000	7.019
42.60	0.000	6.987	*	42.70	0.000	6.956
42.80	0.000	6.924	*	42.90	0.000	6.892
43.00	0.000	6.860	*	43.10	0.000	6.828
43.20	0.000	6.797	*	43.30	0.000	6.765
43.40	0.000	6.733	*	43.50	0.000	6.701
43.60	0.000	6.670	*	43.70	0.000	6.638
43.80	0.000	6.606	*	43.90	0.000	6.574
44.00	0.000	6.542	*	44.10	0.000	6.511
44.20	0.000	6.479	*	44.30	0.000	6.447
44.40	0.000	6.415	*	44.50	0.000	6.384
44.60	0.000	6.352	*	44.70	0.000	6.320
44.80	0.000	6.288	*	44.90	0.000	6.256
45.00	0.000	6.225	*	45.10	0.000	6.193
45.20	0.000	6.161	*	45.30	0.000	6.129
45.40	0.000	6.097	*	45.50	0.000	6.066
45.60	0.000	6.034	*	45.70	0.000	6.002
45.80	0.000	5.970	*	45.90	0.000	5.939
46.00	0.000	5.907	*	46.10	0.000	5.875
46.20	0.000	5.843	*	46.30	0.000	5.811
46.40	0.000	5.780	*	46.50	0.000	5.748
46.60	0.000	5.716	*	46.70	0.000	5.684

time (hr.)	rainfall (in.)	hydrograph (cfs)		time (hr.)	rainfall (in.)	hydrograph (cfs)
46.90	0.000	5.621				
47.00	0.000	5.589	*	47.10	0.000	5.557
47.20	0.000	5.525	*	47.30	0.000	5.494
47.40	0.000	5.462	*	47.50	0.000	5.430
47.60	0.000	5.398	*	47.70	0.000	5.367
47.80	0.000	5.335	*	47.90	0.000	5.303
48.00	0.000	5.271	*	48.10	0.000	5.239
48.20	0.000	5.208	*	48.30	0.000	5.176
48.40	0.000	5.144	*	48.50	0.000	5.112
48.60	0.000	5.080	*	48.70	0.000	5.049
48.80	0.000	5.017	*	48.90	0.000	4.985
49.00	0.000	4.953	*	49.10	0.000	4.922
49.20	0.000	4.890	*	49.30	0.000	4.858
49.40	0.000	4.826	*	49.50	0.000	4.794
49.60	0.000	4.763	*	49.70	0.000	4.731
49.80	0.000	4.699	*	49.90	0.000	4.667
50.00	0.000	4.636	*	50.10	0.000	4.604
50.20	0.000	4.572	*	50.30	0.000	4.540
50.40	0.000	4.508	*	50.50	0.000	4.477
50.60	0.000	4.445	*	50.70	0.000	4.413
50.80	0.000	4.381	*	50.90	0.000	4.350
51.00	0.000	4.318	*	51.10	0.000	4.286
51.20	0.000	4.254	*	51.30	0.000	4.222
51.40	0.000	4.191	*	51.50	0.000	4.159
51.60	0.000	4.127	*	51.70	0.000	4.095
51.80	0.000	4.064	*	51.90	0.000	4.032
52.00	0.000	4.000	*	52.10	0.000	3.968
52.20	0.000	3.936	*	52.30	0.000	3.905
52.40	0.000	3.873	*	52.50	0.000	3.841
52.60	0.000	3.809	*	52.70	0.000	3.777
52.80	0.000	3.746	*	52.90	0.000	3.714
53.00	0.000	3.682	*	53.10	0.000	3.650
53.20	0.000	3.619	*	53.30	0.000	3.587
53.40	0.000	3.555	*	53.50	0.000	3.523
53.60	0.000	3.491	*	53.70	0.000	3.460
53.80	0.000	3.428	*	53.90	0.000	3.396
54.00	0.000	3.364	*	54.10	0.000	3.333
54.20	0.000	3.301	*	54.30	0.000	3.269
54.40	0.000	3.237	*	54.50	0.000	3.205
54.60	0.000	3.174	*	54.70	0.000	3.142
54.80	0.000	3.110	*	54.90	0.000	3.078
55.00	0.000	3.047	*	55.10	0.000	3.015
55.20	0.000	2.983	*	55.30	0.000	2.951
55.40	0.000	2.919	*	55.50	0.000	2.888
55.60	0.000	2.856	*	55.70	0.000	2.824
55.80	0.000	2.792	*	55.90	0.000	2.760
56.00	0.000	2.729	*	56.10	0.000	2.697
56.20	0.000	2.665	*	56.30	0.000	2.633
56.40	0.000	2.602	*	56.50	0.000	2.570
56.60	0.000	2.538	*	56.70	0.000	2.506
56.80	0.000	2.474	*	56.90	0.000	2.443
57.00	0.000	2.411	*	57.10	0.000	2.379
57.20	0.000	2.347	*	57.30	0.000	2.316
57.40	0.000	2.284	*	57.50	0.000	2.252
57.60	0.000	2.220	*	57.70	0.000	2.188
57.80	0.000	2.157	*	57.90	0.000	2.125

time (hr.)	rainfall (in.)	hydrograph (cfs)		time (hr.)	rainfall (in.)	hydrograph (cfs)
58.10	0.000	2.061				
58.20	0.000	2.030	*	58.30	0.000	1.998
58.40	0.000	1.966	*	58.50	0.000	1.934
58.60	0.000	1.902	*	58.70	0.000	1.871
58.80	0.000	1.839	*	58.90	0.000	1.807
59.00	0.000	1.775	*	59.10	0.000	1.744
59.20	0.000	1.712	*	59.30	0.000	1.680
59.40	0.000	1.648	*	59.50	0.000	1.616
59.60	0.000	1.585	*	59.70	0.000	1.553
59.80	0.000	1.521	*	59.90	0.000	1.489
60.00	0.000	1.457	*	60.10	0.000	1.426
60.20	0.000	1.394	*	60.30	0.000	1.362
60.40	0.000	1.330	*	60.50	0.000	1.299
60.60	0.000	1.267	*	60.70	0.000	1.235
60.80	0.000	1.203	*	60.90	0.000	1.171
61.00	0.000	1.140	*	61.10	0.000	1.108
61.20	0.000	1.076	*	61.30	0.000	1.044
61.40	0.000	1.013	*	61.50	0.000	0.981
61.60	0.000	0.949	*	61.70	0.000	0.917
61.80	0.000	0.885	*	61.90	0.000	0.854
62.00	0.000	0.822	*	62.10	0.000	0.790
62.20	0.000	0.758	*	62.30	0.000	0.727
62.40	0.000	0.695	*	62.50	0.000	0.663
62.60	0.000	0.631	*	62.70	0.000	0.599
62.80	0.000	0.568	*	62.90	0.000	0.536
63.00	0.000	0.504	*	63.10	0.000	0.473
63.20	0.000	0.443	*	63.30	0.000	0.416
63.40	0.000	0.390	*	63.50	0.000	0.365
63.60	0.000	0.341	*	63.70	0.000	0.318
63.80	0.000	0.296	*	63.90	0.000	0.275
64.00	0.000	0.255	*	64.10	0.000	0.235
64.20	0.000	0.217	*	64.30	0.000	0.200
64.40	0.000	0.184	*	64.50	0.000	0.168
64.60	0.000	0.153	*	64.70	0.000	0.139
64.80	0.000	0.126	*	64.90	0.000	0.113
65.00	0.000	0.101	*	65.10	0.000	0.090
65.20	0.000	0.079	*	65.30	0.000	0.070
65.40	0.000	0.061	*	65.50	0.000	0.052
65.60	0.000	0.044	*	65.70	0.000	0.037
65.80	0.000	0.031	*	65.90	0.000	0.025
66.00	0.000	0.019	*	66.10	0.000	0.015
66.20	0.000	0.011	*	66.30	0.000	0.007
66.40	0.000	0.004	*	66.50	0.000	0.002
66.60	0.000	0.001	*	66.70	0.000	0.000
66.80	0.000	0.000	*			

PACIFICORP

ENERGY WEST MINING

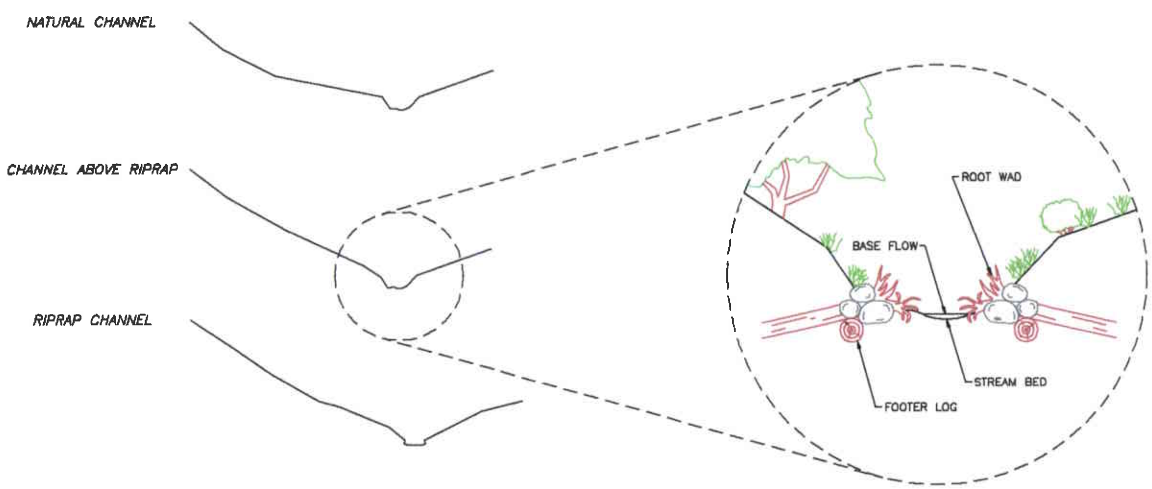
Deer Creek Mine
C/015/018
Mining and Reclamation Plan

Appendix R645-301-700-B

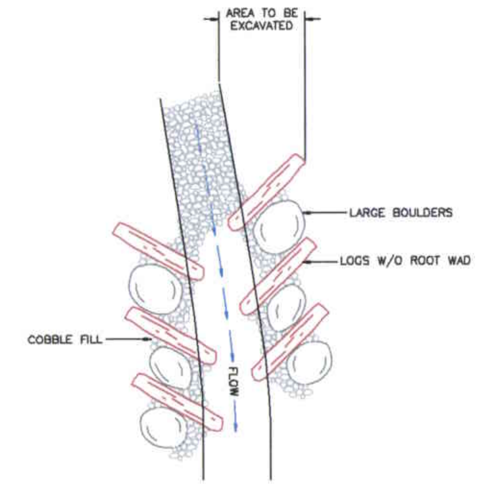
East Mountain Topographic Map: Drawing CM-10529-EM

Final Reclamation Hydrology Map: Drawing DS-1780-D (5 drawings)

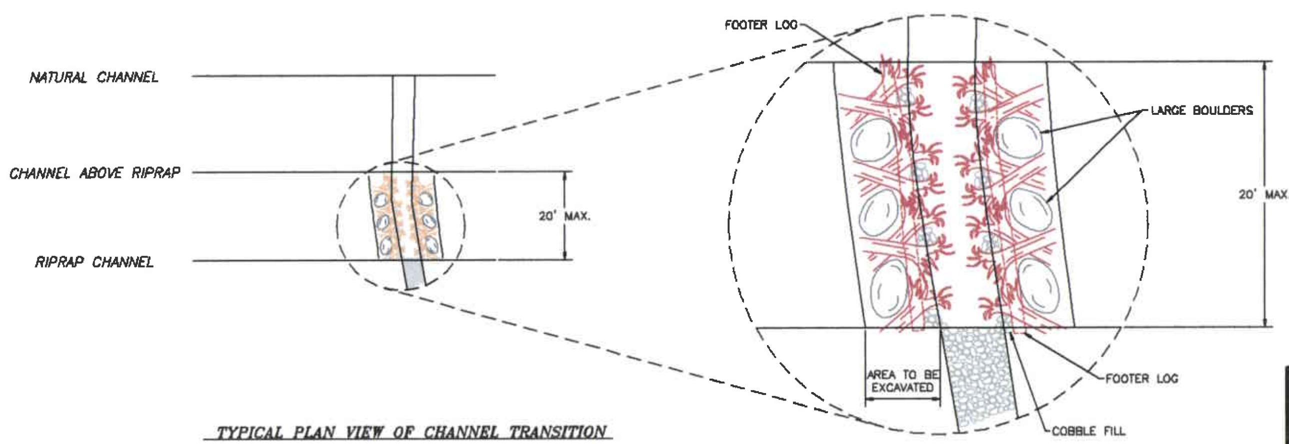
Typical Channel Design Figures: Figures 7-1A thru 7-4A



TYPICAL CROSS-SECTIONAL VIEW OF CHANNEL TRANSITION



TYPICAL PLAN VIEW OF OUTLET OF CHANNEL TRANSITION



TYPICAL PLAN VIEW OF CHANNEL TRANSITION

NOTES

TREE REVETMENT ACTS AS BOTH BANK STABILIZATION AND ENERGY DISSIPATER.

CROSS DESIGN OF LOGS ENSURES STABILITY

BOULDERS EQUAL TO 1.5 TIMES DIAMETER OF LOGS

LOGS DIAMETER EQUAL TO 16 INCH MINIMUN

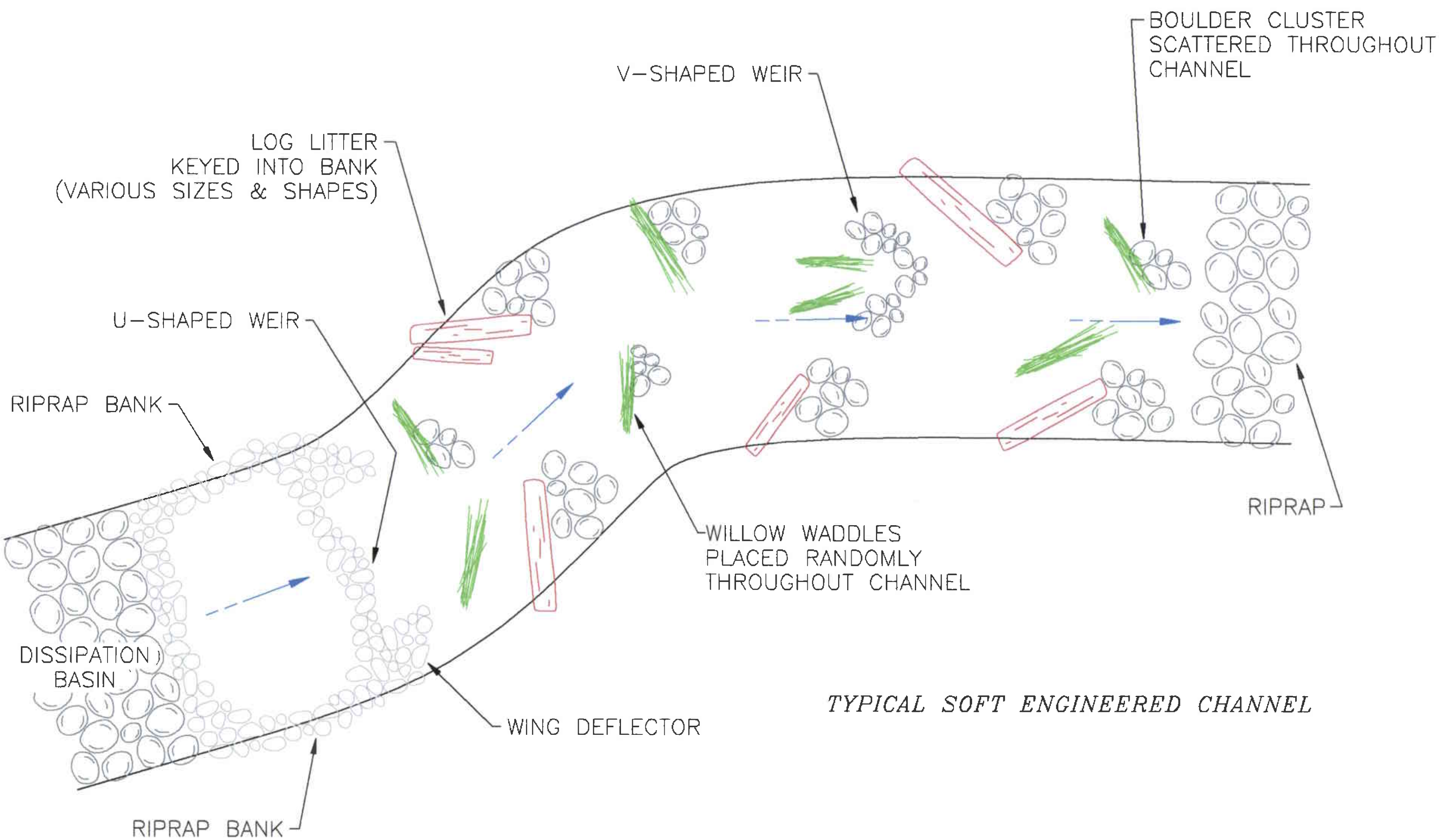
DEER CANYON WILL USE ONLY BOULDER REVETMENTS TO TRANSITION INTO RECLAIMED CHANNEL.

CAD FILE NAME/DISK#: z:\DW\PERMITS\DCMINE\R645-301-700\CHANNEL\7-1A.DWG

ENERGY WEST
MINING COMPANY
HUNTINGTON, UTAH 84528

DEER CREEK MINE
RECLAMATION PLAN
TYPICAL CHANNEL TRANSITION

DRAWN BY: K. LARSEN	FIGURE 7-1A		
SCALE: NONE	DRAWING #:		
DATE: AUGUST 15, 2000	SHEET 1 OF 1	REV. ___	



TYPICAL SOFT ENGINEERED CHANNEL

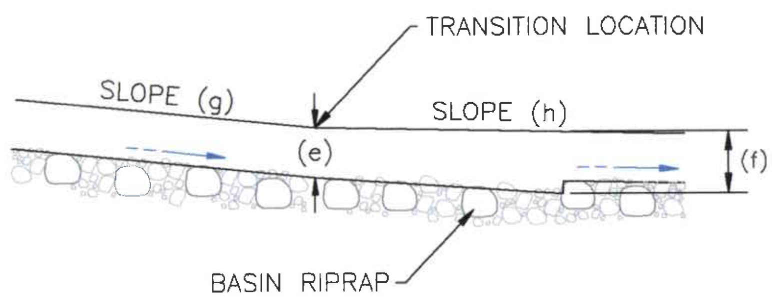
NOTES:

1. DEER AND ELK CANYONS WILL HAVE NO WILLOW WADDLES
2. SEDIMENT CONTROL FABRIC TO BE PLACED ALONG BANKS ON BOTH SIDES IN DEER AND ELK CANYONS

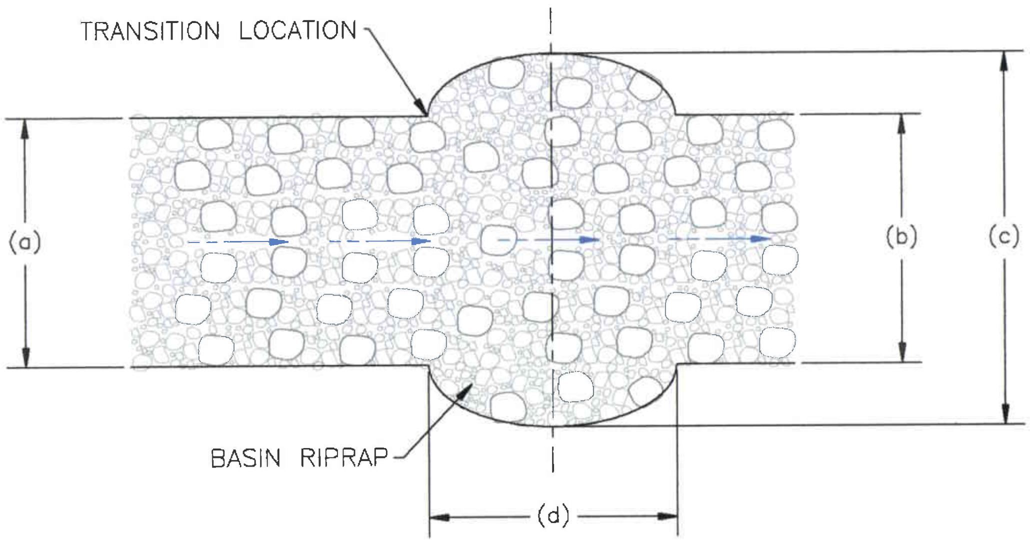
CAD FILE NAME/DISK#: J:\ENV\PERMITS\DCMINE\FIGURE 7-2A.DWG

ENERGY WEST MINING COMPANY HUNTINGTON, UTAH 84528	
DEER CREEK MINE - RECLAMATION PLAN *DEER CANYON, ELK CANYON & DEER CREEK CANYON* *SOFT ENGINEERED CHANNEL*	
DRAWN BY: *K. LARSEN*	*FIGURE 7-2A*
SCALE: *NONE*	DRAWING #:
DATE: *AUGUST 23, 2000*	SHEET *1* OF *1* REV. ___

Dissipation Basin and Station	Upper Channel Width (a)	Lower Channel Width (b)	Basin Width (c)	Basin Length (d)	Depth of Channel (e)	Depth of Basin (f)	Upper Channel Slope (g)	Lower Channel Slope (h)
Deer Creek Drainage Sta. 7+28	10'	10'	15'	10'	2.0'	2.5'	10%	2%
Deer Drainage Sta. 2+43	10'	15'	15'	20'	2.0'	2.5'	21%	3%
Deer Creek Drainage/Elk Canyon Drainage Convergence 24+85	20'	15'	20'	30'	2.5'	3.0'	20%	6%



PROFILE VIEW



PLAN VIEW

TYPICAL DISSIPATION BASIN DESIGN

CAD FILE NAME/DISK#: J:\ENV\PERMITS\DCMINE\FIGURE 7-3A.DWG

ENERGY WEST MINING COMPANY
HUNTINGTON, UTAH 84528

DEER CREEK MINE - RECLAMATION PLAN
DEER DRAINAGE, ELK CANYON DRAINAGE, DEER CREEK DRAINAGE
DISSIPATION BASIN DESIGN

DRAWN BY: K. LARSEN
SCALE: NONE
DATE: AUGUST 24, 2000
FIGURE 7-3A
DRAWING #:
SHEET 1 OF 1
REV. ___

Calculation for Hydraulic Jump

Transition Location: Deer Creek Drainage - Station 8+60

Transition Slopes: 10% to 2%

Flow (Q) = 65.03 cfs

Assume jump occurs down stream. Use equation 10 in R645-301-700:Hydrology

$$\frac{y_2}{y_1} = \frac{1}{2}\left[-1 + \sqrt{1 + \frac{8V^2}{gy_2}}\right]$$

find V:

$V = Q/A,\ A = by + Zy^2$

where b = base of channel
Z = ratio of side slope
y = depth of channel

$$V = \frac{65.03}{10(1.18) + 2(1.18)^2}$$
$$V = 4.46 ft/s$$

Therefore,

$$y_2 = \frac{1.18}{2}\left[-1 + \sqrt{1 + \frac{8(4.46)^2}{(32.2)(1.18)}}\right]$$
$$y_2 = 0.75 ft.$$

Sequent depth or bottom of jump is equal to 0.75 ft. Since this value is > upstream depth (0.65 ft.), jump occurs down stream.

Location of jump with respect to transition point.

Specific Energy of upstream $E_{0.65} = 1.88 ft.$

Find Specific Energy at y_2:

$$E_{0.75} = y + \frac{V^2}{2g}$$

$$E_{0.75} = 0.75 + \frac{\left(\frac{65.03}{10(0.75)+2(0.75)^2}\right)^2}{64.4}$$

$$E_{0.75} = 1.63 ft.$$

Now find slope at y_2

$$S_{0.75} = \left(\frac{Qn}{uAR^{\frac{2}{3}}}\right)^2$$

$$= \left(\frac{65.03 * 0.040}{1.49 * 8.625 * 0.51^{2/3}}\right)^2$$

$$= 0.073 ft./ft$$

Therefore, the location of the jump from the point of channel transition is:

$$\Delta x = \frac{E_{0.75} - E_{0.65}}{S_o - \overline{S}} \quad where \quad \overline{S} = \frac{S_{0.75} + S_{0.65}}{2}$$

so,

$$\Delta x = \frac{1.63 - 1.88}{0.02 - \left(\frac{(0.073 - 0.10)}{2}\right)}$$

$$\Delta x = 3.76 ft. \quad Down \quad stream$$

Basin design parameters:
Bottom width - widen channel to 15 ft.
Channel depth - 2.5 ft. * channel deepened to increase turbulent energy dissipation. Freeboard is 1.32 ft.
Length of Basin - 10 ft. * See typical design on Figure 7-3A

Transition Location: Deer Drainage - Station 2+43

Transition Slopes: 21% to 3%

Flow (Q) = 84.83 cfs

Assume jump occurs down stream. Use equation 10 in R645-301-700:Hydrology

$$\frac{y_2}{y_1} = \frac{1}{2}\left[-1+\sqrt{1+\frac{8V^2}{gy_2}}\right]$$

find V:

$$V = Q/A,\ A = by+Zy^2$$

where b = base of channel
Z = ratio of side slope
y = depth of channel

$$V = \frac{84.83}{15(0.99)+2(0.99)^2}$$
$$V = 5.05 ft/s$$

Therefore,

$$y_2 = \frac{0.99}{2}\left[-1+\sqrt{1+\frac{8(5.05)^2}{(32.2)(0.99)}}\right]$$
$$y_2 = 0.84 ft.$$

Sequent depth or bottom of jump is equal to 0.84 ft. Since this value is > upstream depth (0.65 ft.), jump occurs down stream.

Location of jump with respect to transition point.

Specific Energy of upstream $E_{0.84} = 2.75\ ft.$

Find Specific Energy at y_2:

$$E_{0.84} = y + \frac{V^2}{2g}$$
$$E_{0.84} = 0.84 + \frac{\left(\frac{84.83}{15(0.84)+2(0.84)^2}\right)^2}{64.4}$$
$$E_{0.84} = 1.41 ft.$$

Now find slope at y_2

$$S_{0.75} = \left(\frac{Qn}{uAR^{\frac{2}{3}}}\right)^2$$

$$= \left(\frac{84.83 * 0.046}{1.49 * 14.01 * 4.69^{2/3}} \right)^2$$

$$= 0.052\, ft./ft$$

Therefore, the location of the jump from the point of channel transition is:

$$\Delta x = \frac{E_{0.84} - E_{0.65}}{S_o - \bar{S}} \quad where \quad \bar{S} = \frac{S_{0.84} + S_{0.65}}{2}$$

$so,$

$$\Delta x = \frac{1.41 - 2.75}{0.03 - \left(\frac{(0.052 - 0.21)}{2} \right)}$$

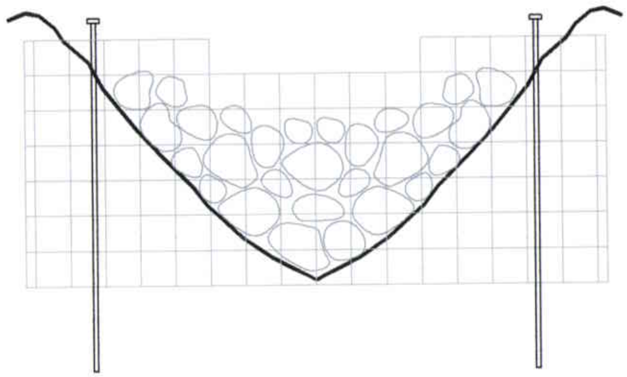
$$\Delta x = 12.3 ft. \quad Down \quad stream$$

Basin design parameters:

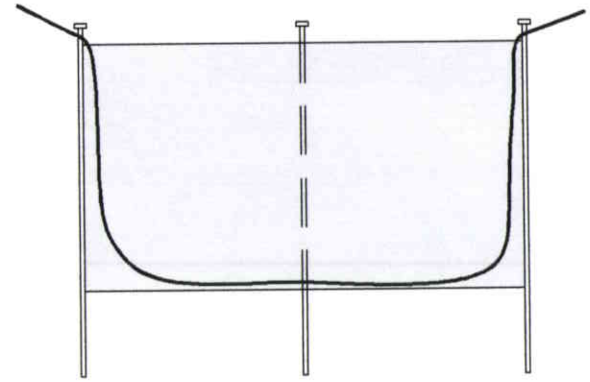
Bottom width - channel remains at15 ft.

Channel depth - 2.5 ft. * channel deepened to increase turbulent energy dissipation. Freeboard is 1.51 ft.

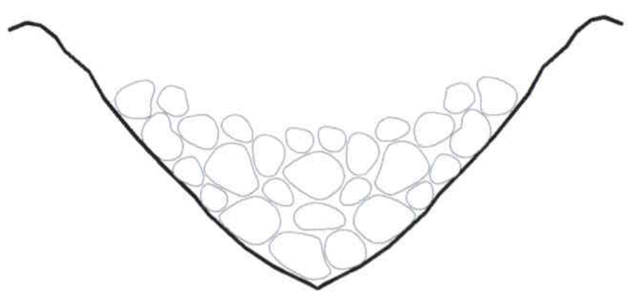
Length of Basin - 20 ft. * See typical design on Figure 7-3A



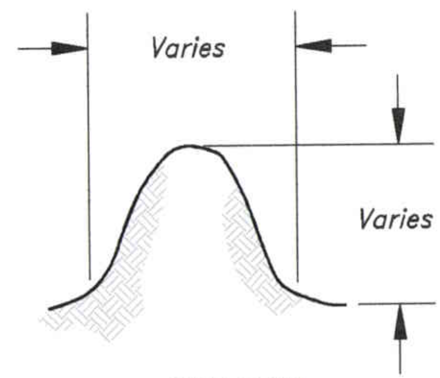
ROCK GABION
(SEDIMENT CONTROL/ENERGY DISSIPATER
WIDTH AND HEIGHT VARIES)



SILT FENCE
(SEDIMENT CONTROL/RUNOFF CONTROL
WIDTH AND HEIGHT VARIES)
BOTTOM KEYED IN TO PREVENT BYPASS
SIDES KEYED IN WHEN NECESSARY



ROCK GABION
(SEDIMENT CONTROL/ENERGY DISSIPATER
WIDTH AND HEIGHT VARIES)
WIRE MESH PLACED ON TOP
OF ROCK WHEN NECESSARY



DIRT BERM
(SEDIMENT CONTROL/RUNOFF CONTROL)

NOTE
STRAW BALES MAY ALSO BE USED TO CONTROL SEDIMENT

CAD FILE NAME/DISK#: J:\ENV\PERMITS\DCMINE\FIGURE 7-4A.DWG

ENERGY WEST
MINING COMPANY
HUNTINGTON, UTAH 84528

DEER CREEK MINE
RECLAMATION PLAN
SEDIMENT CONTROL STRUCTURES

DRAWN BY:	K. LARSEN	FIGURE 7-4A	
SCALE:	NONE	DRAWING #:	
DATE:	AUGUST 15, 2000	SHEET 1 OF 1	REV.

PACIFICORP

ENERGY WEST MINING

Deer Creek Mine
C/015/018
Mining and Reclamation Plan

Appendix R645-301-700-C

<u>Slope Profile Locations Used in Calculating RUSLE Factors: Drawing DS-1795-D</u>

<u>RUSLE Input Parameters for Soil Loss Calculations: 3.5" Floppy Disk</u>

PACIFICORP

ENERGY WEST MINING

Deer Creek Mine
C/015/018
Mining and Reclamation Plan

Appendix R645-301-700-D

Channel Design Results for the Deer Creek Mine Drainages

Deer Creek Canyon Channel Design

Deer Creek 0+00 - 7+28
Worksheet for Trapezoidal Channel

Project Description	
Project File	j:\environmental\permits\dcmine\r645-301-700\channel design\dcdraina.fm2
Worksheet	Deer Creek 0+00 - 7+28
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.250000 ft/ft	
Left Side Slope	2.000000 H : V	
Right Side Slope	2.000000 H : V	
Bottom Width	10.00	ft
Discharge	65.03	cfs

Results		
Depth	0.52	ft
Flow Area	5.80	ft²
Wetted Perimeter	12.35	ft
Top Width	12.10	ft
Critical Depth	1.02	ft
Critical Slope	0.025522 ft/ft	
Velocity	11.22	ft/s
Velocity Head	1.96	ft
Specific Energy	2.48	ft
Froude Number	2.86	
Flow is supercritical.		

Deer Creek 7+28 - 8+60
Worksheet for Trapezoidal Channel

Project Description	
Project File	j:\environmental\permits\dcmine\r645-301-700\channel design\dcdraina.fm2
Worksheet	Deer Creek 7+28 - 8+60
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.036	
Channel Slope	0.100000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	10.00	ft
Discharge	65.03	cfs

Results		
Depth	0.65	ft
Flow Area	7.29	ft²
Wetted Perimeter	12.89	ft
Top Width	12.58	ft
Critical Depth	1.02	ft
Critical Slope	0.020673	ft/ft
Velocity	8.93	ft/s
Velocity Head	1.24	ft
Specific Energy	1.88	ft
Froude Number	2.07	
Flow is supercritical.		

Deer Creek 8+60 - 13+93
Worksheet for Trapezoidal Channel

Project Description	
Project File	j:\environmental\permits\dcmine\r645-301-700\channel design\dcdraina.fm2
Worksheet	Deer Creek 8+60 - 13+93
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.046	
Channel Slope	0.020000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	10.00	ft
Discharge	65.03	cfs

Results		
Depth	1.18	ft
Flow Area	14.65	ft²
Wetted Perimeter	15.30	ft
Top Width	14.74	ft
Critical Depth	1.02	ft
Critical Slope	0.033753	ft/ft
Velocity	4.44	ft/s
Velocity Head	0.31	ft
Specific Energy	1.49	ft
Froude Number	0.78	
Flow is subcritical.		

Deer Creek 13+93 - 16+10
Worksheet for Trapezoidal Channel

Project Description	
Project File	j:\environmental\permits\dcmine\r645-301-700\channel design\dcdraina.fm2
Worksheet	Deer Creek 13+93 - 16+10
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.039	
Channel Slope	0.120000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	10.00	ft
Discharge	103.38	cfs

Results		
Depth	0.84	ft
Flow Area	9.81	ft^2
Wetted Perimeter	13.76	ft
Top Width	13.36	ft
Critical Depth	1.36	ft
Critical Slope	0.022547	ft/ft
Velocity	10.54	ft/s
Velocity Head	1.73	ft
Specific Energy	2.57	ft
Froude Number	2.17	
Flow is supercritical.		

Deer Creek 16+10 - 20+72
Worksheet for Trapezoidal Channel

Project Description	
Project File	j:\environmental\permits\dcmine\r645-301-700\channel design\dcdraina.fm2
Worksheet	Deer Creek 16+10 - 20+72
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.041	
Channel Slope	0.180000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	10.00	ft
Discharge	103.38	cfs

Results		
Depth	0.77	ft
Flow Area	8.87	ft²
Wetted Perimeter	13.44	ft
Top Width	13.07	ft
Critical Depth	1.36	ft
Critical Slope	0.024919	ft/ft
Velocity	11.66	ft/s
Velocity Head	2.11	ft
Specific Energy	2.88	ft
Froude Number	2.50	

Flow is supercritical.

Deer Creek 20+72 - 23+34
Worksheet for Trapezoidal Channel

Project Description	
Project File	j:\environmental\permits\dcmine\r645-301-700\channel design\dcdraina.fm2
Worksheet	Deer Creek 20+72 - 23+34
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.041	
Channel Slope	0.220000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	10.00	ft
Discharge	103.38	cfs

Results		
Depth	0.73	ft
Flow Area	8.30	ft^2
Wetted Perimeter	13.24	ft
Top Width	12.90	ft
Critical Depth	1.36	ft
Critical Slope	0.024919	ft/ft
Velocity	12.45	ft/s
Velocity Head	2.41	ft
Specific Energy	3.13	ft
Froude Number	2.74	
Flow is supercritical.		

Deer Creek 23+34 - 25+44
Worksheet for Trapezoidal Channel

Project Description	
Project File	j:\environmental\permits\dcmine\r645-301-700\channel design\dcdraina.fm2
Worksheet	Deer Creek 23+34 - 25+44
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.044	
Channel Slope	0.200000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	10.00	ft
Discharge	184.31	cfs

Results		
Depth	1.08	ft
Flow Area	13.20	ft^2
Wetted Perimeter	14.85	ft
Top Width	14.34	ft
Critical Depth	1.92	ft
Critical Slope	0.026336	ft/ft
Velocity	13.96	ft/s
Velocity Head	3.03	ft
Specific Energy	4.11	ft
Froude Number	2.57	
Flow is supercritical.		

Deer Creek 25+44 - 32+00
Worksheet for Trapezoidal Channel

Project Description	
Project File	j:\environmental\permits\dcmine\r645-301-700\channel design\dcdraina.fm2
Worksheet	Deer Creek 25+44 - 32+00
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.037	
Channel Slope	0.060000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	15.00	ft
Discharge	184.31	cfs

Results		
Depth	1.12	ft
Flow Area	19.23	ft^2
Wetted Perimeter	19.99	ft
Top Width	19.46	ft
Critical Depth	1.56	ft
Critical Slope	0.018990	ft/ft
Velocity	9.59	ft/s
Velocity Head	1.43	ft
Specific Energy	2.54	ft
Froude Number	1.70	
Flow is supercritical.		

Deer Canyon Channel Design

Deer Canyon 0+00 - 2+43
Worksheet for Trapezoidal Channel

Project Description	
Project File	j:\environmental\permits\dcmine\r645-301-700\channel design\dcdraina.fm2
Worksheet	Deer Canyon 0+00 - 2+43
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.210000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	10.00	ft
Discharge	84.83	cfs

Results		
Depth	0.65	ft
Flow Area	7.29	ft²
Wetted Perimeter	12.89	ft
Top Width	12.58	ft
Critical Depth	1.20	ft
Critical Slope	0.024459	ft/ft
Velocity	11.64	ft/s
Velocity Head	2.11	ft
Specific Energy	2.75	ft
Froude Number	2.70	
Flow is supercritical.		

Deer Canyon 2+43 - 8+29
Worksheet for Trapezoidal Channel

Project Description	
Project File	j:\environmental\permits\dcmine\r645-301-700\channel design\dcdraina.fm2
Worksheet	Deer Canyon 2+43 - 8+29
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.046	
Channel Slope	0.030000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	15.00	ft
Discharge	84.83	cfs

Results		
Depth	0.99	ft
Flow Area	16.74	ft^2
Wetted Perimeter	19.41	ft
Top Width	18.94	ft
Critical Depth	0.95	ft
Critical Slope	0.033490	ft/ft
Velocity	5.07	ft/s
Velocity Head	0.40	ft
Specific Energy	1.39	ft
Froude Number	0.95	
Flow is subcritical.		

Elk Canyon Channel Design

Elk Canyon 0+00 - 4+00
Worksheet for Trapezoidal Channel

Project Description	
Project File	j:\environmental\permits\dcmine\r645-301-700\channel design\dcdraina.fm2
Worksheet	Elk Canyon 0 - 4+00
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.046	
Channel Slope	0.050000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	10.00	ft
Discharge	94.44	cfs

Results		
Depth	1.13	ft
Flow Area	13.83	ft^2
Wetted Perimeter	15.05	ft
Top Width	14.51	ft
Critical Depth	1.28	ft
Critical Slope	0.031809	ft/ft
Velocity	6.83	ft/s
Velocity Head	0.72	ft
Specific Energy	1.85	ft
Froude Number	1.23	
Flow is supercritical.		

Elk Canyon 4+00 - 6+48
Worksheet for Trapezoidal Channel

Project Description	
Project File	j:\environmental\permits\dcmine\r645-301-700\channel design\dcdraina.fm2
Worksheet	Elk Canyon 4+00 - 6+48
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.170000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	10.00	ft
Discharge	94.44	cfs

Results		
Depth	0.73	ft
Flow Area	8.38	ft^2
Wetted Perimeter	13.27	ft
Top Width	12.92	ft
Critical Depth	1.28	ft
Critical Slope	0.024052	ft/ft
Velocity	11.27	ft/s
Velocity Head	1.97	ft
Specific Energy	2.71	ft
Froude Number	2.47	
Flow is supercritical.		

Elk Canyon 6+48 - 8+63
Worksheet for Trapezoidal Channel

Project Description	
Project File	j:\environmental\permits\dcmine\r645-301-700\channel design\dcdraina.fm2
Worksheet	Elk Canyon 6+48 - 8+63
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.041	
Channel Slope	0.240000 ft/ft	
Left Side Slope	2.000000 H : V	
Right Side Slope	2.000000 H : V	
Bottom Width	10.00	ft
Discharge	94.44	cfs

Results		
Depth	0.67	ft
Flow Area	7.60	ft²
Wetted Perimeter	13.00	ft
Top Width	12.68	ft
Critical Depth	1.28	ft
Critical Slope	0.025270 ft/ft	
Velocity	12.42	ft/s
Velocity Head	2.40	ft
Specific Energy	3.07	ft
Froude Number	2.83	
Flow is supercritical.		

PACIFICORP

ENERGY WEST MINING

Deer Creek Mine
ACT/015/018
Mining and Reclamation Plan

Appendix R645-301-700-E

Riprap Gradation Calculations for Filter Design of Channels

Deer Creek Channel

Rip-Rap Gradation

Segment - **0+00 - 7+28**

	(ft)	(mm)
D_{50} Riprap $= x$	1.04	317.2
D_{15} RipRap $= y$	0.31	95.16

D_{50} Filter $= a$
D_{15} Filter $= b$
D_{85} Filter $= c$

Criteria
1) D_{50} RipRap/D_{50} Filter < 40
2) D_{15} RipRap/D_{15} Filter > 5
   D_{15} RipRap/D_{15} Filter < 40
3) D_{15} RipRap/D_{85} Filter < 5

or

1) $x/a < 40$
2) $y/b > 5$
   $y/b < 40$
3) $y/c < 5$

Therefore,

	(mm)	(ft)	(in)
D_{50} Filter >	7.93	0.03	1/2
D_{15} Filter <	19.03	0.06	3/4
D_{15} Filter >	2.38	0.01	1/4
D_{85} Filter >	19.03	0.06	3/4

Deer Creek Channel

Rip-Rap Gradation

Segment - **7+28 - 8+60**

	(ft)	(mm)
D_{50} Riprap = x	0.57	173.85
D_{15} RipRap = y	0.17	52.155

D_{50} Filter = a
D_{15} Filter = b
D_{85} Filter = c

Criteria
1) D_{50} RipRap/D_{50} Filter < 40
2) D_{15} RipRap/D_{15} Filter > 5
   D_{15} RipRap/D_{15} Filter < 40
3) D_{15} RipRap/D_{85} Filter < 5

or

1) $x/a < 40$
2) $y/b > 5$
   $y/b < 40$
3) $y/c < 5$

Therefore,

	(mm)	(ft)	(in)
D_{50} Filter >	4.35	0.01	1/4
D_{15} Filter <	10.43	0.03	1/2
D_{15} Filter >	1.30	0.00	1/4
D_{85} Filter >	10.43	0.03	1/2

Deer Creek Channel

Rip-Rap Gradation

Segment - **13+93 - 16+10**

	(ft)	(mm)
D_{50} Riprap = x	0.89	271.45
D_{15} RipRap = y	0.27	81.435

D_{50} Filter = a
D_{15} Filter = b
D_{85} Filter = c

Criteria
1) D_{50} RipRap/D_{50} Filter < 40
2) D_{15} RipRap/D_{15} Filter > 5
   D_{15} RipRap/D_{15} Filter < 40
3) D_{15} RipRap/D_{85} Filter < 5

or

1) x/a < 40
2) y/b > 5
   y/b < 40
3) y/c < 5

Therefore,

	(mm)	(ft)	(in)
D_{50} Filter >	6.79	0.02	1/4
D_{15} Filter <	16.29	0.05	1/2
D_{15} Filter >	2.04	0.01	1/4
D_{85} Filter >	16.29	0.05	1/2

Deer Creek Channel

Rip-Rap Gradation

Segment - **16+10 - 20+72**

	(ft)	(mm)
D_{50} Riprap $= x$	1.16	353.8
D_{15} RipRap $= y$	0.50	152.134

D_{50} Filter $= a$

D_{15} Filter $= b$

D_{85} Filter $= c$

Criteria

1) D_{50} RipRap/D_{50} Filter < 40
2) D_{15} RipRap/D_{15} Filter > 5
   D_{15} RipRap/D_{15} Filter < 40
3) D_{15} RipRap/D_{85} Filter < 5

or

1) $x/a < 40$
2) $y/b > 5$
   $y/b < 40$
3) $y/c < 5$

Therefore,

	(mm)	(ft)	(in)
D_{50} Filter >	8.85	0.03	1/2
D_{15} Filter <	30.43	0.10	1.0
D_{15} Filter >	3.80	0.01	1/4
D_{85} Filter >	30.43	0.10	1.0

Deer Creek Channel

Rip-Rap Gradation

Segment - **20+72 - 23+34**

	(ft)	(mm)
D_{50} Riprap = x	1.32	402.6
D_{15} RipRap = y	0.40	120.78

D_{50} Filter = a

D_{15} Filter = b

D_{85} Filter = c

Criteria

1) D_{50} RipRap/D_{50} Filter < 40
2) D_{15} RipRap/D_{15} Filter > 5
   D_{15} RipRap/D_{15} Filter < 40
3) D_{15} RipRap/D_{85} Filter < 5

or

1) $x/a < 40$
2) $y/b > 5$
   $y/b < 40$
3) $y/c < 5$

Therefore,

	(mm)	(ft)	(in)
D_{50} Filter >	10.07	0.03	1/2
D_{15} Filter <	24.16	0.08	1.0
D_{15} Filter >	3.02	0.01	1/4
D_{85} Filter >	24.16	0.08	1.0

Deer Creek Channel

Rip-Rap Gradation

Segment - **23+34 - 25+44**

	(ft)	(mm)
D_{50} Riprap = x	1.86	567.3
D_{15} RipRap = y	0.56	170.19

D_{50} Filter = a

D_{15} Filter = b

D_{85} Filter = c

Criteria

1) D_{50} RipRap/D_{50} Filter < 40
2) D_{15} RipRap/D_{15} Filter > 5
   D_{15} RipRap/D_{15} Filter < 40
3) D_{15} RipRap/D_{85} Filter < 5

or

1) $x/a < 40$
2) $y/b > 5$
   $y/b < 40$
3) $y/c < 5$

Therefore,

	(mm)	(ft)	(in)
D_{50} Filter >	14.18	0.05	1/2
D_{15} Filter <	34.04	0.11	1 1/2
D_{15} Filter >	4.25	0.01	1/4
D_{85} Filter >	34.04	0.11	1 1/2

Deer Creek Channel

Rip-Rap Gradation

Segment - **25+44 - 32+00**

	(ft)	(mm)
D_{50} Riprap = x	0.65	198.25
D_{15} RipRap = y	0.20	59.475

D_{50} Filter = a

D_{15} Filter = b

D_{85} Filter = c

Criteria

1) D_{50} RipRap/D_{50} Filter < 40
2) D_{15} RipRap/D_{15} Filter > 5

   D_{15} RipRap/D_{15} Filter < 40
3) D_{15} RipRap/D_{85} Filter < 5

or

1) x/a < 40
2) y/b > 5

   y/b < 40
3) y/c < 5

Therefore,

	(mm)	(ft)	(in)
D_{50} Filter >	4.96	0.02	1/4
D_{15} Filter <	11.90	0.04	1/2
D_{15} Filter >	1.49	0.00	1/4
D_{85} Filter >	11.90	0.04	1/2

Deer Canyon Channel

Rip-Rap Gradation

Segment - **0+00 - 2+43**

	(ft)	(mm)
D_{50} Riprap = x	1.12	341.6
D_{15} RipRap = y	0.34	102.48

Criteria

1) D_{50} RipRap/D_{50} Filter < 40
2) D_{15} RipRap/D_{15} Filter > 5
   D_{15} RipRap/D_{15} Filter < 40
3) D_{15} RipRap/D_{85} Filter < 5

or

1) $x/a < 40$
2) $y/b > 5$
   $y/b < 40$
3) $y/c < 5$

D_{50} Filter = a
D_{15} Filter = b
D_{85} Filter = c

Therefore,

	(mm)	(ft)	(in)
D_{50} Filter >	8.54	0.03	1/2
D_{15} Filter <	20.50	0.07	3/4
D_{15} Filter >	2.56	0.01	1/4
D_{85} Filter >	20.50	0.07	3/4

Elk Canyon Channel

Rip-Rap Gradation

Segment - **4+00 - 6+48**

	(ft)	(mm)
D_{50} Riprap $= x$	1.05	320.25
D_{15} RipRap $= y$	0.32	96.075

D_{50} Filter $= a$
D_{15} Filter $= b$
D_{85} Filter $= c$

Criteria
1) D_{50} RipRap/D_{50} Filter < 40
2) D_{15} RipRap/D_{15} Filter > 5
   D_{15} RipRap/D_{15} Filter < 40
3) D_{15} RipRap/D_{85} Filter < 5

or

1) $x/a < 40$
2) $y/b > 5$
   $y/b < 40$
3) $y/c < 5$

Therefore,

	(mm)	(ft)	(in)
D_{50} Filter >	8.01	0.03	1/2
D_{15} Filter <	19.22	0.06	3/4
D_{15} Filter >	2.40	0.01	1/4
D_{85} Filter >	19.22	0.06	3/4

Elk Canyon Channel

Rip-Rap Gradation

Segment - **6+48 - 8+63**

	(ft)	(mm)
D_{50} Riprap = x	1.31	399.55
D_{15} RipRap = y	0.39	119.865

D_{50} Filter = a
D_{15} Filter = b
D_{85} Filter = c

Criteria
1) D_{50} RipRap/D_{50} Filter < 40
2) D_{15} RipRap/D_{15} Filter > 5
   D_{15} RipRap/D_{15} Filter < 40
3) D_{15} RipRap/D_{85} Filter < 5

or

1) x/a < 40
2) y/b > 5
   y/b < 40
3) y/c < 5

Therefore,

	(mm)	(ft)	(in)
D_{50} Filter >	9.99	0.03	1/2
D_{15} Filter <	23.97	0.08	1
D_{15} Filter >	3.00	0.01	1/4
D_{85} Filter >	23.97	0.08	1